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VOLUME 9, No. 5 MAY 1957

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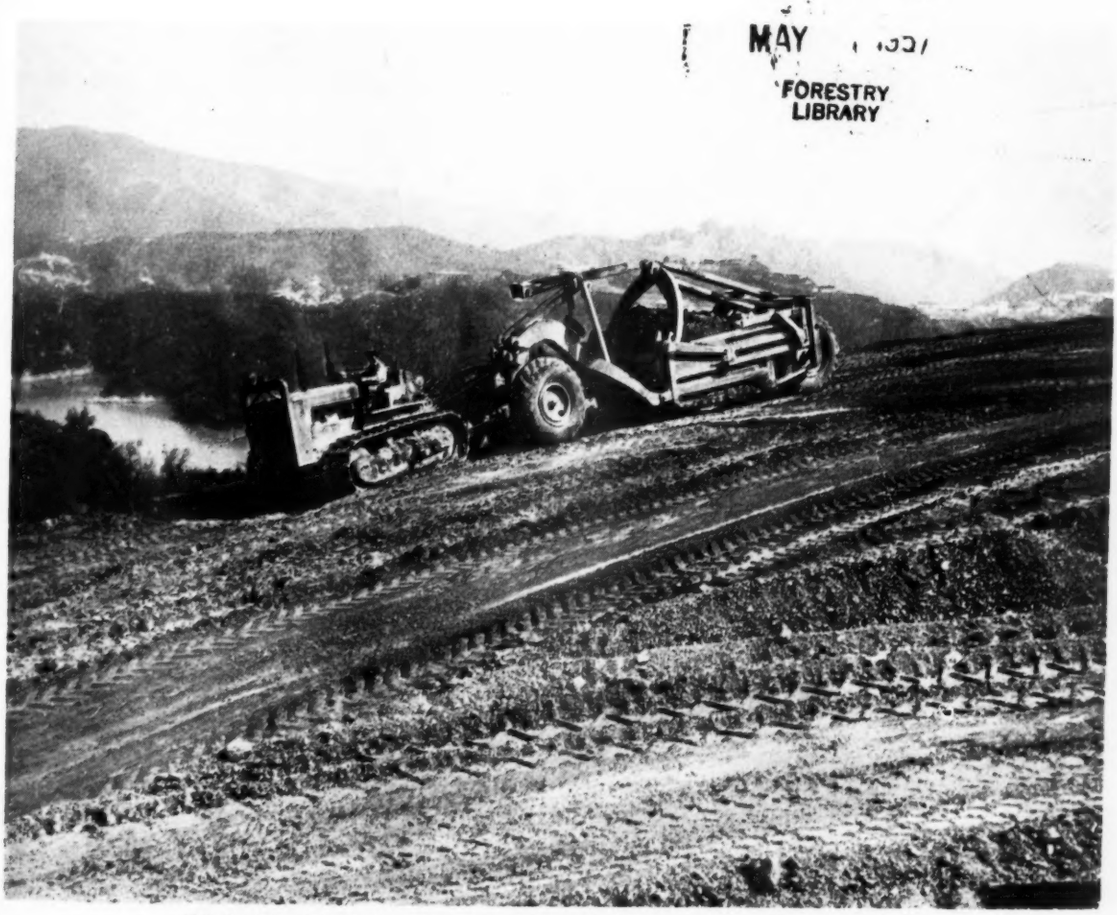

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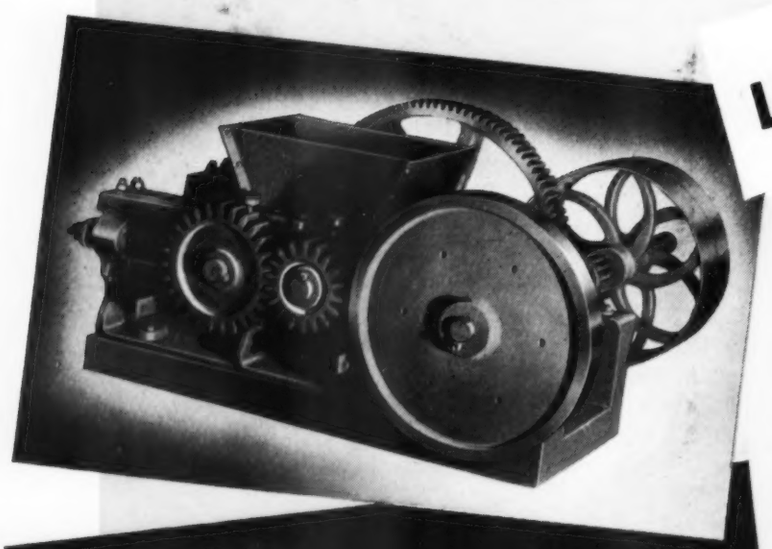

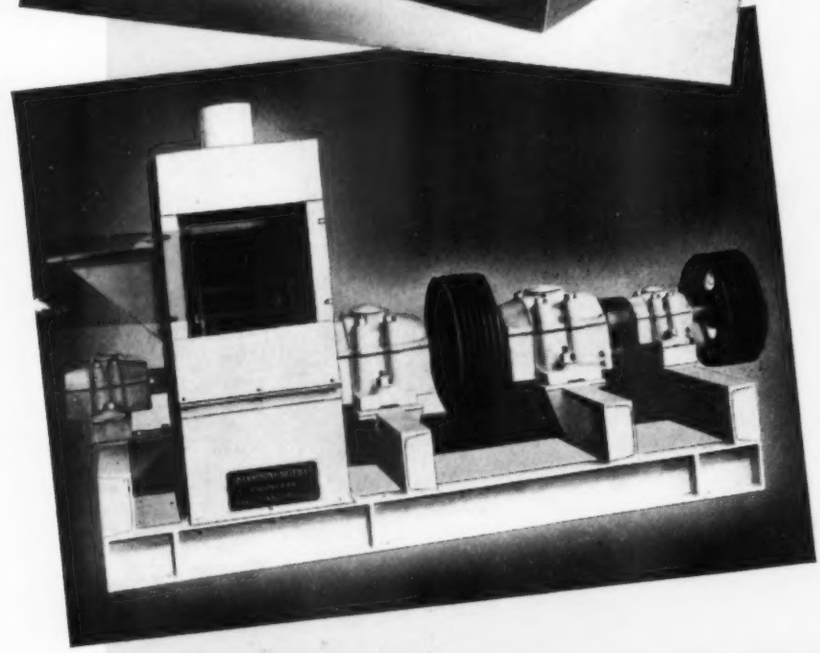

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WORLD CROPS

Editor: Frank Cooke, A.R.C.S., B.Sc., A.M.I.Chem.E., E.D.

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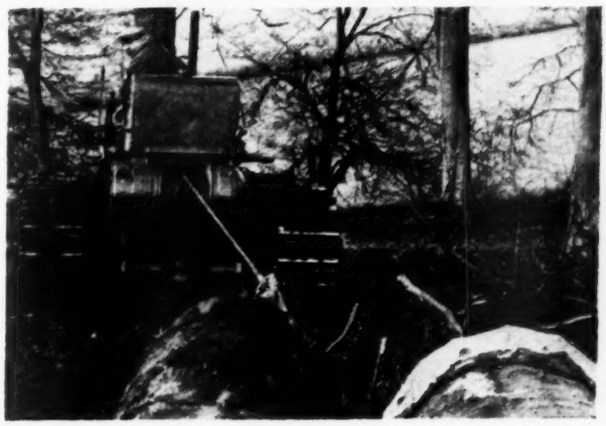

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Editorial Comment

Cart before horse

PROPOSALS to convert the Philippine form of government to the parliamentary system have been considered and rejected. In a recent speech, Mr. Raul Manglapus, Under-Secretary of Foreign Affairs, declared that the parliamentary system would open the door to Communist subversion. ' The success of the parliamentary system in England ', he said ' is due to the presence there of a strong moral force around which tradition has evolved a responsible two-party government. The result elsewhere, where this moral force is lacking, has provided a splendid opportunity for the Communist party to place itself in power by a series of clever coalitions and compromises '.

It is an unfortunate fact that the pattern in most of the territories new to self-government is similar. Politics has become the road to rapid promotion, without the boring necessity of adequate preparation; politics is the dominating force in agriculture and, in consequence, there is no stability and no confidence; and where there is no confidence there can be no progress. With an illiterate electorate it is an easy matter to win votes by making wild promises.

In the course of a parliamentary election in a former British colony (which shall be nameless) the Leftist candidate held a meeting at the entrance of one of the most efficient and well-run plantations. He promised his audience of simple villagers that when he was returned to Parliament the plantation would be theirs. At the end of the meeting, he solemnly took down names in a ledger and parcelled out the estate on the basis of one acre per head, depending on the size of the family. Gifted with a loud voice and an assertive personality, he was successful; it did not occur to anyone that he had bribed the electorate and that his election should have been declared null and void.

It is fortunate that in Britain there is a nice balance between the Government, and the agricultural and commercial interests, all working together with one common purpose to make the best use of the available land, to bring waste lands into effective cultivation, and to produce more food and still more food for an ever-increasing population; to the returned exile, this mutual confidence is most impressive for it is an undoubted fact that, during the last five years the face of agriculture in Britain has been changed. No political capital has been made of this. In fact, it is doubtful whether the name of the responsible Minister is known to more than one in ten of the people in Britain.

Now let us turn to Russia, the land of wild political experiment. What of the first Five-Year Plan, as a result of which millions died of starvation? What of the revolutionary, Professor Lysenko, and his mad theories of the transmutation of plants which received the blessing of the great god, Stalin, and who since, of dire necessity, has had to be totally repudiated as a responsible scientist. We must not forget these things, and others too . . .

The danger in the newly-self-governing territories stems from wild talk of nationalising prosperous agricultural industries, and of placing research under political control not in order to make research more effective or to ensure the effective application of the results of research; on the contrary, the purpose is political interference—naked and unashamed. The existing Boards of Administration which have either been elected by the planters or the farmers, or appointed by the Government, or both, according to law, are no longer to be trusted. In future, the power is to be in the hands of one man—the politician.

An important objective in the world of today is to produce more and still more food. If the race between production and increase in population is lost—war is inevitable and we shall all have to reconcile ourselves to the idea of the atom bomb. That is why it is essential to give first place to Agriculture and put Politics back where it belongs.

Plastic mulches

FOR many years now it has been the practice to lay down rolls of bituminised paper in the pineapple fields of Hawaii and to plant the suckers through the paper. In England, too, we have learned recently that fibreglass mulches are being used for protecting strawberries. Now comes news from the U.S.A. that plastic mulches are being tested for tomato growing.

The mulch is in the form of black polyethylene sheets made in strips 4 ft. wide and with holes cut at regular intervals. These are laid out on the land in parallel rows with 3-ft. paths between the rows and the seedling tomato plants are planted through the holes. This type of mulching prevents competition from weeds, conserves soil moisture, retains soil fumigant, prevents soluble fertiliser from being washed down into the soil and keeps the ground cool during the day and warm at night.

Test plots with this plastic covering are said to have yielded up to 14 tons of tomatoes per acre, compared with only 8 tons from the unmulched controls. The cost of plastic mulching is stated to be about U.S. $200 per acre and it is considered that the life of the material is about three years, but it will obviously be necessary to lift and move the plastic after each cropping to the space occupied by the path.

Robbing Peter to pay Paul

ABOUT 25 years ago there was much activity in the tea, coffee and rubber estates of India, Ceylon and Malaya in connection with the making of composts. The so-called Indore process was followed, whereby rough vegetation was put into a pit or in a heap with the natural 'starters', cow dung, wood ashes and urine earth, the last dug up from the floor of the cattle shed. After about three months, with suitable watering and aeration, a good compost results with a carbon/nitrogen ratio of about 15 to 1.

Lincoln compost or farmyard manure was made in the rainy season in India. By this process, fresh, dried bedding is spread daily in the cattle shed and left to accumulate and decompose to a compost.

The amount of plant foods in Indore compost containing 50% moisture is about 0.5% nitrogen, 0.25% phosphoric acid and 0.5% potash. Under estate conditions in India, up to two tons dung per annum can be collected per head of cattle, and this bulk can be increased five or six times by composting.

At the period under discussion, artificial fertilisers were still suspect by many planters and organic manures were preferred, if available. Cattle manure could be purchased in India for Rs.3/- (4*s.* 6*d.*) per ton at that time. The actual cost of production of compost was only about Rs.2/- (3*s.*) per ton, spent wholly on labour. Since most of the composting was done in the dry season when there was little essential work for men and tasks, often nominal, had to be found for them in order to make a wage, useful work in gathering and composting green stuff was welcome.

Many extravagant claims were made for compost, but soil scientists never succumbed to these, although the value of bulk manure and the possible benefits from minor elements* therein, were sometimes admitted.

Field experiments on tea estates showed that the nitrogen in compost gave about half the return in extra crop as the same amount of nitrogen given as sulphate of ammonia. Thus, 150 lb. of that fertiliser per acre —a common dose in 1930—supplying about 30 lb. nitrogen, gave as much extra crop as compost spread at the rate of 6 tons per acre and supplying 60 lb. nitrogen, together with large amounts of phosphoric acid and potash. Still, even at this rate of return, the making of compost was an economic process.

Nevertheless, by the year 1940, composting was losing its popularity, in spite of the shortage of sulphate of ammonia during the war years, and no attempt has been made to revive the practice. Several reasons may be given for this. Tea, coffee and rubber lands are usually well shaded and generously supplied with organic matter. It is reckoned in Assam that the prunings from the bushes annually give 3-10 tons per acre of green stuff, and the leguminous foliage dropped from shade trees adds a further 10-30 tons per acre.

It may be argued that these quantities and the foodstuffs they contain come, in part, from the planted area itself, and that the net gain to the soil is much less than the figures suggest. This is true.

It can be stated, however, that composting on a large scale lost its attraction, because year by year the procedure becomes more expensive as the green matter has to be sought farther and farther afield. Careful records show that an acre of shrub land may yield 40-50 tons of green stuff per acre at the first year's cutting, 5 tons at the second, after which only patchy grass grows. The cut areas near the composting pits rapidly become denuded of worth-while growth, and their value as agricultural land is accordingly diminished. To cut and carry green stuff from afar puts the project out of court financially. The conclusion is that composting on a large scale at a reasonable cost is 'robbing Peter to pay Paul'.

*According to Scharrer and Prun, the average ratio of nutrients in farmyard manure is nitrogen (1); phosphorus (0.29); potash (1.13); calcium (0.94); magnesium (0.26); boron (0.92. 10^{-3}); cobalt (0.0055. 10^{-3}); copper (0.53. 10^{-3}); manganese (11.52. 10^{-3}); molybdenum (0.0034. 10^{-3}); and zinc (4.32. 10^{-3}). Abs. *Soils & Fert.* 1956, **19**, 287.

The price of tea

THE report† on the supply of tea in the U.K. was recently presented to Parliament by a Commission set up in pursuance of Section 9 of the Monopolies and Restrictive Practices (Inquiry and Control) Act, 1948. The main purpose of the Commission was to enquire into the reasons for the marked rise in tea prices over the period August 1954 to February 1955.

With regard to the sale of tea, the Commission finds that about 55% of that supplied in the U.K. in 1954 was sold at the London auctions, where obligatory conditions are laid down and the volume of tea sold is regulated from time to time. Furthermore, at least one-half of the tea distributed in the U.K. is sold subject to resale price maintenance. The question of the International Tea Agreement between the producing countries with regard to the amount of tea exported and the planting up of new areas is also dealt with, but the fact is recorded that the Agreement was not in operation when the Commission received its reference from the Board of Trade in 1955, neither is it in effect now. However, in spite of these apparent breaches of the Act, the Commission concluded that the tea trade in this country is conducted on keenly competitive lines and, furthermore, it was considered that the severe fluctuations in the price of tea which have taken place since decontrol have not been due to the existence of 'monopoly' conditions or restrictive practices in the U.K. tea trade.

Apart from these reassuring conclusions, the report contains much of interest. Thus there is a brief but

†Obtainable from H.M.S.O., price 3*s.* 6*d.*

adequate description of the cultivation and manufacture of tea, followed by an account of the organisation of tea companies in India and Ceylon, which includes some mention of the agency house system. The organisation of the tea trade from the producers' end is then outlined, and this naturally leads to an account of the overseas and London auctions, conditions of sale and so on. The processes of blending, packing and distribution follow, with mention of the arrangements amongst buyers. Price fluctuations between 1952 and 1955 and probable factors involved are discussed, and sub-section (*d*) of chapter vi fully illustrates the problem which faces the tea buyer.

In order to judge the build-up of the tea industry from the selection and planting of the tea seed to the handing of the packet over the counter, the complexity of the project must be fully realised, as well as the capital involved and the risks run. A good estate of 1,000 acres, producing 1,500 lb. of tea per acre, costs £200 per acre to bring into bearing (total £200,000), and another equal sum to build and equip a modern factory (grand total £400,000 expenditure), before profits begin in the seventh or eighth year from starting. These properties cannot be run separately to the best advantage and it is far preferable to have groups managed by agency houses. Such amalgamations bring the benefits of steady policy in estate management and make for co-operation in the shipping and marketing of the crop.

The demand for tea is always expanding, albeit at an irregular rate. The supply is also increasing, due either to new extensions or the enhanced out-turn of present areas following on improved methods and treatment. It takes about seven years from seed to bring an area into bearing and obviously it is a practical impossibility to equate, to a nicety, supply and demand looking that period ahead. Accordingly, some international scheme of control and export is desirable if slumps and booms are to be reduced or avoided.

From the point of view of the blender, packer and distributer, the problems are equally numerous and difficult. Adequate stocks must be maintained, although tea is not a commodity which can, in practice, be stored indefinitely. Cargoes do not arrive at a steady rate, neither is quality always available as required. The amount of tea stored in bond in the U.K. since the war is of the order 100 million lb., about two and a half months' consumption. Then there is tea on the water, on its way to London, and tea in the 'pipe-line' between the docks and the customer. Considering the general state of world affairs since the war, and the distributor's anxiety to meet his particular demands, fluctuation in auction prices must be expected. It may be concluded that the tea industry has done well in these trying times in keeping the people of the U.K. supplied with tea at a price which works out at $\frac{1}{4}d.$ to $\frac{1}{2}d.$ per cup to the home consumer.

Documentation

THE collection, cataloguing, abstracting and indexing of scientific information is today an essential service for the advancement of knowledge. It is of course quite impossible for the scientific worker to read every paper that is published, even if it were desirable to do so, and it is also necessary for him to be able to draw on information from publications in foreign languages. It is unfortunately only too true that a scientific textbook is already out of date by the time it is published.

Evidence of the tremendous interest in the subject was provided when Messrs. H. J. Barber, R. E. Fairbarn and J. H. Hamence jointly participated in a three-paper meeting on the subject. The main hall of the Society of Chemical Industry was packed to capacity and the reading of the papers was followed by a very lively discussion.

The most important conclusion reached was that the situation is now quite out of hand because the output of scientific publications is increasing in geometrical progression, and it is becoming increasingly difficult to keep pace. The dissemination of new knowledge must be speedy and comprehensive to ensure the steady progress and to prevent the unnecessary repetition of work already carried out. As it is, the time lag between the original date of publication, the appearance of its abstract, and its inclusion in an index is increasing. In some instances it was shown to be as much as three years. The late Prof. Bragg once said that 'unless a paper can have an immediate effect, it might never have been written'.

Some scientific workers are reluctant to publish their work at all, on the grounds that finality has not been reached or for various other reasons; in the main, however, vast imponderable masses of information are presented to the poor abstractor; sometimes there is neither a summary nor conclusions, and the essential facts are obscured by masses of non-essential information. As a result it is difficult for him to interpret the facts correctly, and the papers, too, are not easily understandable to workers in allied fields of research.

It was apparent that the traditional methods of publication and abstracting need to be overhauled. Scientists were urged to show more restraint in their communications and not to publish unnecessarily, and above all, to see that their papers only contained essential information and were provided with a proper summary.

This would simplify the work of the abstractor and enable him to deal with a very much larger number of papers. It was urged that the use of casual abstractors should cease as abstracting was now a full-time occupation. It was felt, too, that only carefully selected papers should be abstracted, and that the abstracts should be very brief and little more than an amplification of the title of the publication.

The essential requirements for research are a complete and up-to-the-minute information service for current literature, and a searching service to look up past publications and patents and provide fuller details of particular aspects. These should be separate and distinct branches if the two services are to be equally efficient and the needs of modern research are to be answered promptly and effectively.

Plankton—a world crop?

THE passively drifting, pelagic life of the sea consists mainly of microscopic organisms, and the amount of this material—' plankton '—in the oceans of the world is of far greater magnitude than that of all the larger animals and plants.

Plankton is highly nutritional. It has been found that the vitamins in cod liver oil are not synthesised in the fish itself but can be traced back to the vitamins in the plankton that it consumes. Experiments have shown that it is possible for plankton to be used directly as food, and it would appear that the food resources of the world could be immeasurably increased, except for the fact that there are difficulties in designing methods for its collection.

Dr. Maxwell Doty, Chairman of the Department of Botany at the University of Hawaii, has been investigating at Eniwetok in the Pacific processes by which plankton is produced. For this purpose he found that a helicopter was the only way of collecting samples of sea water practically simultaneously from both sides of an atoll reef.

Nitrogen through the sprayer?

A FEW years ago, when it became appreciated that plant foods could be assimilated by plants through their leaf system, the possibility of spray application for fertilisers was being enthusiastically studied. But results have been disappointing—certainly so for farm crops. For trace nutrients whose addition to soils would be dubious for soil fixation reasons, the spray method is more or less obligatory; but it is also suitable for handling these very small rates per acre. For major or macro-nutrients the maximum spray solution concentrations that can be given without some risk of foliage damage are equivalent to fairly low rates of supply per acre. It is a fair verdict, on present evidence, that for the major nutrients, there will be few farm-cropping cases where spraying could be economic or specially advantageous.

It still remained possible that some nitrogen could be usefully and economically applied to a growing crop if it was incorporated with a herbicidal spray solution. Then, assuming that a weed-controlling spray operation was to be given to the crop in any case, this method of giving a nitrogen top-dressing would be cheaper in application costs than a separate dressing with solid fertiliser. Now even this hope seems to have been over-optimistic.

A paper by G. N. Thorne in the *Journal of Agricultural Science* (1957, **48**, 266) has reported wheat trials with a dual spray of 2, 4-D and urea or ammonium nitrate, the nitrogen being given in the spray at the rate of 0.5 cwt. of the nutrient per acre. Uptake of nitrogen from solid dressings was about twice that from the sprayed nitrogen; though this caused only a small difference in the yield responses in these tests, it could under different conditions cause more serious differences. Retention of the sprayed nitrogen by the crop's leaf system was poor, partly because at this spray timing—for weed control—the leaf system is small, partly because heavy rain followed one of the experimental applications. It is possible that nitrogen, applied in solution, is more easily washed out of soils than nitrogen when applied as solid fertiliser. But however these results are analysed, the fact remains that this low uptake from sprayed nitrogen makes it an unpromising method of application even in association with herbicide.

Food drive in Asia

THE countries of Asia have many peoples in various stages of development and with varying heritages of history and religion; they have one basic thing in common—the huge and increasing numbers of people that must be fed. The rapid rate of population growth casts a long shadow over any gradual improvement in agricultural production.

Viewing the region as a whole (with the exception of China, who is not an FAO member), we see that it produced more in 1956 than it did in 1955 and that on average diets have improved since 1953 in quantity, if not in quality. The crops increased slightly more than did the population. On the other hand, at the present rates of population growth there will be 20% more new mouths to be filled by 1970. What can the governments do to improve on or even maintain the present food supply per person?

This was the big problem of the conference arranged recently by FAO at Bandung, Indonesia. In an atmosphere of earnestness and openness the delegates reviewed the work being done in each country, dwelling on the failures as well as the successes among their projects. They concluded that agricultural production had increased about 15% since 1953—when the last FAO Regional Conference for Asia and the Far East was held—but because of the increase in population the amount per person was only up by about 6%, and because of irregular distribution many people still did not have enough to eat. The need for still greater increases in production was apparent to all.

The conference asked FAO to continue giving technical assistance, to continue to expand its rôle as a catalyst, to evaluate the work in progress and maintain statistics of production and formulate policy.

THE ENGINEER TO THE RESCUE

L. DUDLEY STAMP, C.B.E., D.LIT., D.SC., LL.D.
(Formerly Chief Adviser on Rural Land Utilisation to the Ministry of Agriculture)

We are privileged to publish this thought-provoking article from Prof. Dudley Stamp on the subject of the up-grading or reconstitution of poor soils and the reclamation of tidal swamps and low-lying areas using modern earth-moving and levelling equipment. What was impossible in the past may now be feasible. It is certainly not a question which should be lightly dismissed.

THE rapid increase in population all over the world is leading to a steadily increasing pressure of population on land resources, especially land for the production of foodstuffs for the sustenance of mankind and for raw materials of vegetable origin which he needs in ever-increasing quantity for his various material wants.

Population and land

Of course, the problem of population pressure was foreseen by Malthus as early as the end of the 18th century, but that was before the discovery of the vast potential of the new lands of the Americas and of Australia. His ideas have long been pigeonholed, but in the last few decades it has been made quite clear that with the increased death control and the survival of individual human beings to a greater age than has ever been known before, there is now a very definite increase of population pressure on land resources.

Taking the world as a whole this may not yet be acute; we find that the 2,600,000,000 people known now to be existing on the earth's surface have each still a share of land, if equally divided amongst them, of something like 14 acres. But we must eliminate one-fifth of this total area as being too cold ever to be likely to support permanent human settlement, another fifth as too dry and with no known available supplies of water, another fifth as too elevated or too mountainous, and another 10% as virtually devoid of soil and consisting essentially of rock.

This leaves about 30% of the earth's surface available for permanent human settlement, based upon agricultural production. This represents a share of some four to five acres per head of existing population. Of land which is at the present time actually being used, it takes the produce on an average of approximately one acre to support one human being. In some countries where land is abundant, far more land is actually used to support one human being than this figure. For example, in the U.S.A. it is more like three and a half acres per head of population, whereas in Japan something like six or seven persons must be supported from the produce of a single acre.

The pressure of population is steadily increasing, and many countries must now be regarded as over-populated from the point of view that they cannot support their existing population from the produce of their own home territory under existing systems of cultivation. This, indeed, is the position which we have reached in the British Isles.

If we like to take England, Wales and Scotland, we have an area of about $1\frac{1}{8}$ acres of land of all sorts per head of population. If we take England and Wales alone, this is reduced to about 0.8 acre per head of population, including of course the virtually uninhabited and uncultivated moorlands of the Pennines, of the Lake District and of Wales, Dartmoor and elsewhere. Of farmland, that is land in grass and crops, enclosed within farm boundaries, there is only a little over half-an-acre per head of population in England and Wales, or in England, Wales and Scotland.

At our present standard of living and with our varied diet, which tends to be extravagant of land, it takes rather over an acre to provide us with the food for one person. The best record in this regard was reached in the height of the plough-up campaign during the war when, it has been shown, about 1.17 acres were required to feed each member of our population.

Photo: Royal Netherlands Embassy, London

A ditch being dug in reclaimed land in the Zuider Zee

An Aveling Barford shuttle dumper emptying 9 cu. yd. of soil

Productivity of soils

But Britain is an extraordinarily varied country. Quite apart from those areas which are of little value for production, because of elevation and steepness, there is an enormous variation in our soils. If we take the average good farmland of the midlands and east of England as equivalent to one unit per acre, we may roughly say that the best of our soils, for example those in the Fenland, are about twice as productive, whereas the poorer lands of the west could be regarded as about half as productive. It is officially estimated that the productivity of our hill lands and of our rough grazing can be reckoned in terms of ten acres of such land equivalent to one acre of improved land. In other words, they are only about one-tenth as productive.

The classification of land, according either to its actual productivity or its potential productivity, is an extraordinarily difficult subject, and such a statement cannot be anything but an intelligent guess at the position. Nevertheless, such differences in productivity play a very important part, or should play a very important part, in the present system of town and country planning which we have for the country as a whole.

Rural land utilisation

Let us take for example the desirability of establishing a new town. If a new town requires 5,000 acres, and is located on our rich good farmland, we may say that the country thereby must sacrifice 5,000 units of potential productivity or p.p.u. If, unfortunately, such a town were sited on the very best of our soils, the country would thereby be robbed of something like 10,000 units. If, on the other hand, such a town is located on poor, sandy land of comparatively little value agriculturally, then the country would not be robbed of more than 500 p.p.u.

This reasoning is, of course, behind the generally accepted national policy of avoiding where possible building and other forms of construction on the better agricultural lands, and the efforts to conserve such land in agricultural production. It may be argued that the use of such land is far more important for other purposes than the production of food, which we can obtain from overseas, but twice in the past generation we have been subject in this country to siege conditions, and whatever may be our present requirement it would seem foolish to destroy our potential of food production when we can both have our cake and eat it by reserving our more fertile lands for agricultural production.

However, the question does arise, is it not possible to upgrade or actually to alter the character of some of the lands of this country, or indeed of any other country, so as to make them more productive? This is where the mechanical engineer may, indeed, come to the rescue.

Good land and bad

What are the essential requirements of land that it should be constituted ' good agricultural land '? I would say that first there is the actual texture of the soil. Though soil or the soil-forming material may be of adequate depth, it may be too coarse, such as light sandy land, which in the farmer's terminology is ' hungry '—in other words the material is so coarse that rain falling on it soaks through with great rapidity. The land remains permanently hungry, because if it is fed with manures, artificial or natural, they are rapidly washed through the soil and lost to the plants growing therein. From another point of view it can be described as overdrained. At the other extreme we have the heavy clays—intractable, difficult to work when too wet or too dry, and difficult to drain, liable to become acid, and with many other disadvantages.

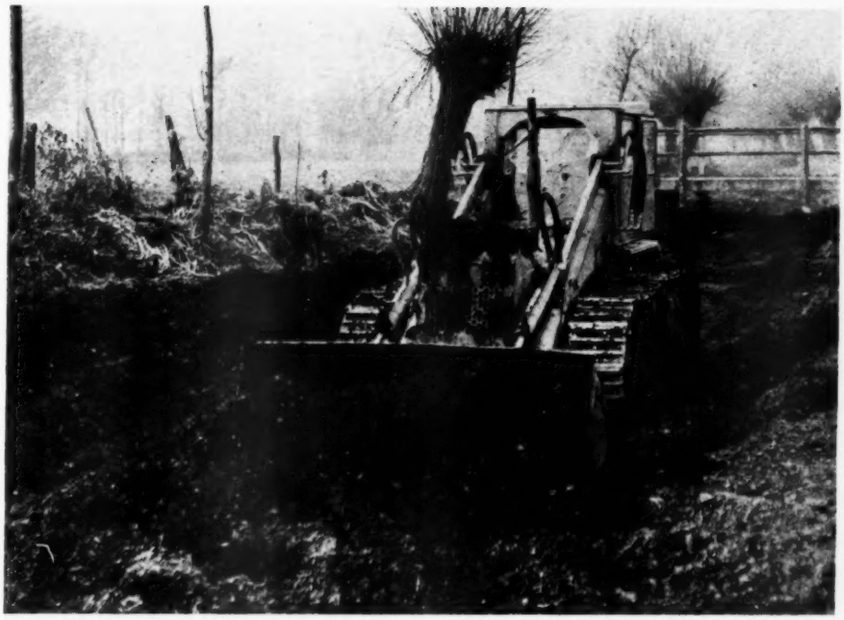
The best lands for agriculture nearly always have a soil texture which involves a mixture of clay, silt and sand, so that they constitute loams. The clay fraction allows such soils to be retentive of moisture and of plant food. The sand fraction permits ready working and the possibility of maintaining a good tilth, or, as the farmer would say, of keeping the land ' in good heart '. If such soils are deficient in any of the essential requirements they can be fed with artificial or natural manures to remedy such defects, the point being that, because of the texture, such manures are retained by the soil.

Secondly, a soil must have adequate depth, and with ploughing going down to eight or nine inches one may

look upon the depth of, say, ten inches or a foot as being a minimum for good agricultural land before one reaches the bedrock, be it relatively hard or of a different character. A soil of adequate depth, and of the right textural consistency, usually develops quite readily a good soil structure. Gardeners know very well, as do farmers, the way in which a good well-worked soil develops a crumb structure. A soil with a good crumb structure has the right natural drainage to support the growth of plants. It is, of course, a great advantage if a soil is relatively free from stones which interfere with the proper formation of tap roots in the case of tap-rooted plants.

A third requirement of good agricultural land, of course, is adequate drainage. Provided the permanent water table is not too high and liable to reach the surface as it is in some of our alluvial marshlands, a soil with a good texture and a good structure is likely to be either well drained naturally, or capable of ready drainage; and the same applies to soils of adequate depth.

All our good soils therefore agree in having a good texture, a good structure and adequate depth, a relative freedom from stones, and good drainage. But the combination is by no means common and if we take category 1 of the Land Utilisation Survey's scheme of land classification we find that lands with such soils cover less than two million acres in England and Wales, or something like 5% only of the total surface. They are, in fact, very precious.



The ' Brayloader ' 25 scooping up a load of soil and levelling land

The question arises, is it possible to construct such soils artificially? There is nothing new in this idea. For centuries, perhaps for thousands of years, the Chinese have understood the need of building up soils in this way. A farmer on light sandy land has been able to discuss the problem with a farmer some distance away on heavy clay land, and has amicably arranged an exchange of 10,000 baskets of the one type for 10,000 baskets of the other. Where labour is cheap and abundant there has been no inherent difficulty in getting the labourers to carry the 20,000 baskets involved, perhaps a distance of many miles, eventually giving each farmer a good loamy soil by mixing the two.

The British farmer in the Middle Ages, and indeed later, did much the same. If he had light sandy land he might at the same time have had an underlying deposit of clay or marl from which he could dig out the heavier clay or marl and spread it over his light land. This process of ' marling ' was very widely carried out in many parts of the midlands where the surface soil was a light glacial sand and needed more body. In later years the practice fell into disuse simply because rising labour costs rendered such a process uneconomic.

Similarly it is a characteristic of many of our chalklands that the surface is covered with a deposit of clay-with-flints, extremely heavy clay deficient in lime. Yet at a few feet below the surface has been the natural

A Ruston-Bucyrus dragline cleaning and widening a dyke in East Anglia

Photo: International Harvester Co.

A monster ' Payscraper ' with a full load—note the driver

chalk of which the clay-with-flints is simply an insoluble residue on the surface. What was easier than to dig a pit in the chalk, to cart the chalk and spread it over the clay lands? In many cases the chalking of such fields has had an effect which has lasted for at least a hundred years. But again the practice has fallen into disuse because of the actual cost of labour for carting the chalk.

Earth moving

My argument is that the time has now come when we should use some of our modern earth-moving machinery for carrying out work similar to that done by hand in the past. One can think of many farms in the chalklands with such tracts of heavy clay-with-flints, or farms in the midlands on a very heavy boulder clay, where the mechanical spreading of chalk or of sand over the area as a thin layer which, when ploughed in, would give a loamy soil of good texture. The farmers of Devon and north Cornwall have, of course, been doing this from time immemorial by carting Bude sand from the coast, spreading it over the clay fields and ploughing it in. They thereby improve the textural consistency by adding the sand, but the sand is very rich in lime so that at the same time they are liming their soil. It is a matter of no little surprise to many that a canal some 30 miles in length was constructed in the 1820s from Bude inland for the primary purpose of conveying this lime rich sea sand to farmers in the neighbourhood.

Surely it would be a fairly easy task in some of the light-soiled areas of East Anglia or the midlands to get clay from a neighbouring source, a pit, and again spread it over the land so that once more the farmer could plough the two together and get a good loamy soil. The spreading would need to be done to such a depth as to secure the minimum required for farming operations.

For the implementation of such an idea, it would be necessary to have a soil expert who would lay down the correct proportions for different agricultural purposes, it would need the engineer—the expert muck-shifter—to say how the operation could be performed. But surely we have a magnificent opportunity of converting relatively poor tracts of the surface of this country into the really valuable first class soils which we need so badly. It is a national need, and costs should not necessarily be related to the precise return which could be gained at the moment, or the precise value of the land thereby constituted.

Marsh reclamation

There is yet another way in which modern earth-moving machinery should come to our rescue, and that is in the reclamation of some of our tidal marshes and low-lying swampy areas. The cost of dyking and ditching such land has, in the past, been prohibitive but are these costs still valid? If, let us say, 10% or possibly even 20% of the half-million acres lying between high and low tide marks round the coasts of England and Wales could be reclaimed, what a valuable addition this would represent.

I have to admit that we could not reclaim a lot of this land because of the sandy and poor quality of the soil-forming constitutents which result when drainage has been carried out, but again, with the moving of masses of earth and the mixing of silt and sand, is it not possible to visualise the actual manufacture of good soils by the methods which I have suggested above?

All this may be a wild dream, but surely it is worth while to think seriously when the results could be of such enormous benefit to the country.

Food Project in Northern Rhodesia

A 4½-mile dyke, forerunner of a £30-million-a-year food - growing scheme on the Kafue Flats, has been completed.

The dyke will enable agricultural experts to go ahead with the first part of the gigantic project, a 700-acre pilot scheme. Miles of irrigation channels have been dug and the pump station, which will keep irrigation water supplied to crops and pump out excess water in the wet season, is already in operation. The first seeds—30 acres of rice—have been planted and the first food crop of the project should be harvested this month.

Workmen are now building a field meteorological station at the site where weather experts will begin compiling detailed logs to give future farm workers the information they need on the rainfall, wind, temperature and evaporation conditions on the Flats.

Various crops will be tried on the pilot scheme. The pilot ' polder ' of 700 acres will include experimental stations and four farms—two European farms of 150 acres each and two native farms of 20 acres each. These will be worked along the lines on which it is visualised the whole project will finally emerge.

JUNGLE CLEARANCE AND RECLAMATION

C. S. L. FRANCES, M.I.MECH.E.(S. AFRICA), M.I.B.A.E.

(*Plant and Equipment Manager, Gal Oya Development Board, Ceylon*)

This is an abridged version of a paper recently presented to the Institution of British Agricultural Engineers. The paper describes the large-scale development of forest and secondary jungle for irrigation and dry-land agriculture and deals with the use of heavy machinery for jungle clearance, standardisation of equipment future trends and the training of personnel.

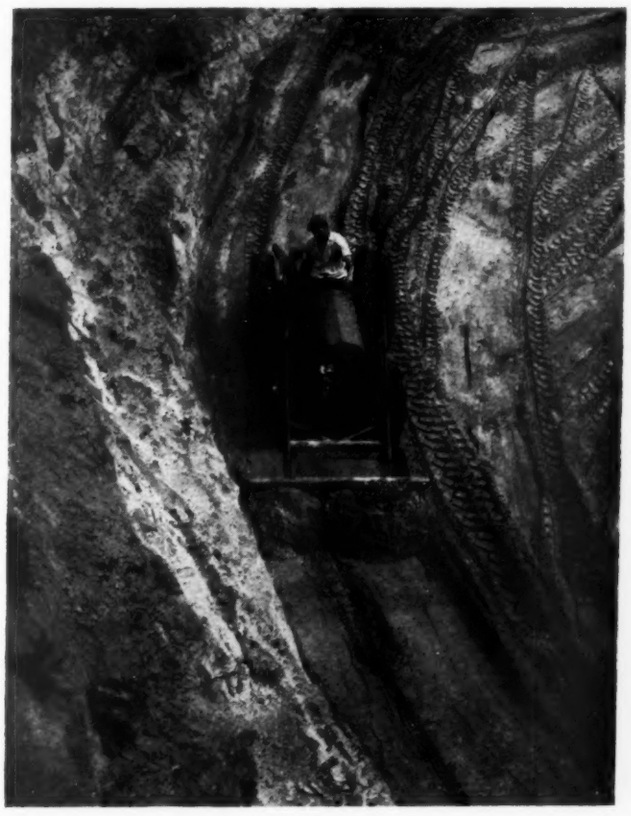
MECHANISATION is a means whereby manipulative capability it utilised to extract and direct the power and purpose of a machine. 'Man with a machine has a thousand hands'. No longer do our limitations stem from the physical duress of manual labour. Operative efficiency, rates of accomplishment, the speed at which work is done, the rate of extraction of power potential and its application to the task are dependent upon the effects on the operator of the relative rigour of the conditions of work on the one hand and the rated output of a machine on the other. The former is diminishing rapidly as a result of a progressive move towards power-assisted controls. The power output of machines is increasing and in the final analysis man will be found to possess an infinite capacity to produce work, machine size alone being the limiting factor.

Today there has been attained an alliance between the engineer and agriculturist, a closer companionship of once scarcely related sciences made essential by the urgent need for increased food production and conservation and development of natural resources, tasks which by virtue of their magnitude can be accomplished only by mechanised means. The development of the American continent and certain Commonwealth countries was made possible in a relatively brief period mainly because the great food potential became realisable under a system of mechanised processes. Vast areas beyond the capacity of man and animal power to handle were brought under the plough, and because population expansion and industrial advancement depends largely upon a balanced agricultural economy, the machine must be accepted as an indispensable component of modern farming practice.

Technical training

On mechanised schemes abroad due consideration must be given to the training of future technical personnel. At the outset it is necessary to take into account the local background from the industrial and agricultural point of view, if this training is to be established upon a basis which will embrace those specific characteristics governing the present stage of development and those which will shape the future. The drain on financial resources as a result of ignorance of basic fundamentals of mechanical engineering is great. The plant and equipment is heavily punished, not by deliberate intent, but as a result of the absence of the enlightened mind and failure to develop the 'engineering soul'.

In training there are two inseparable components, namely, the 'know why' and the 'know how'. To know why a thing should be done is of equal importance as to know how. When it is known why adjustments to machinery should be made at given times the significance of neglecting to carry these



A Massey-Harris tractor grading and levelling a piece of land

Photo: National Institute of Agricultural Engineering

A Caterpillar tractor clearing secondary jungle

out on schedule will be better appreciated, and if a preventive maintenance programme is to be established on sound lines, training in basic theory must be a primary aim.

One of the first buildings to be put up on any large-scale land development project, therefore, should be the training school.

Cost-consciousness

On State - financed development schemes there is a tendency to minimise the importance of what would appear to be, within themselves, trivial savings, an attitude which is, perhaps, engendered by the very magnitude of the funds available. On the East African Groundnut Scheme there existed the ' millions thirty ' complex. On the Gal Oya Scheme in Ceylon there could well have developed the ' millions four hundred ' complex had the necessity not been anticipated to inculcate a degree of cost-consciousness in the minds of the administrative and supervisory personnel generally.

Equipment

The main classes of equipment used on the Gal Oya Scheme in Ceylon were: (*a*) track-type tractors (heavy), (*b*) track-type tractors (medium), (*c*) track-type tractors (light), (*d*) pneumatic-tyred tractors (heavy), (*e*) motorised scrapers, (*f*) bottom dumpers, (*g*) rear dumpers, (*h*) mechanical loaders and dragline equipment, (*i*) motor graders, (*j*) road rollers, (*k*) portable power plant, (*l*) stationary power plant, (*m*) agricultural tractors (wheeled type), (*n*) agricultural implements, and (*o*) road motor vehicles.

Land clearing

A primary decision relates to the type of equipment with which operations will be carried out. Normally in areas of high rainfall, where the standing timber is relatively large, the root boles extensive and the anchorages deep, the chain method of felling is used. This involves employment of tractors in the heavy classification, working co-operatively in teams of six, disposed as follows: two pairs of tractors in tandem work at each end of a heavy naval-type anchor chain; two supporting tractors move in the rear of the chain pairs, each fitted with tree-dozer equipment, to assist in pushing down the heavier trees.

Operation ' ripping and rooting ' is carried out using the same machines employing cable - operated rippers equipped with three tines. The operation usually involves two movements over the cleared land in opposite directions. The roots thus expelled from the ground are piled by hand labour and burned or raked into piles, using mechanised root-rake equipment.

Where root-ripping is employed the soil is penetrated to a depth of approximately 24 in., and thorough working of the surface and subsoils is achieved with minimum inversion effects. The operation thus becomes one of breaking down the rooted soil into reasonably good tilth, using heavy disk harrows rather than one of heavy initial ploughing. This operation may be done using machines of the medium-power class. The rate of accomplishment per machine-hour is 1 to 2 acres, depending mainly upon the compactive conditions and root populations.

Undeveloped land in southern African territories, unlike that in the monsoon areas of Asia, is usually covered with a scrub-like forest, with few trees of substantial girth or height. Developing such land by mechanised means would be simplified in so far as chain felling with heavy tractors could be obviated. It may be done using less specialised equipment of lower capital and machine-hour costs. In some cases it may be preferable to use hand-operated winches, as at present widely employed in certain parts of Africa; in others the rear-mounted power-driven winches on the heavier class of agricultural tractors. Again, there is the slower and cheaper method of destroying standing timber using the ring-barking techniques such as are employed in Australia.

The ring-barking method is, perhaps, the most preferable because it involves no surface disturbance of the soil. The leaf, bark and canopy of the trees decays and is taken into the soil; the root stock remains to decay and serves as a bond for the soil. When the time comes to remove the trees the operation is the relatively simple one of extraction, using tractor-operated or hand winches. This method takes time and is advocated where the forward planning is conceived on a sufficiently far-reaching basis.

In areas of very tall tropical rain forest it may prove impossible to fell and pile all the vegetation with large tractors working quickly in teams. In some circumstances the major problem is how to pile on the ground the vast bulk of material which, prior to felling, was standing upright. In the Belgian Congo much progress has been made in the development of a system of mechanically-assisted manual felling which provides for the larger trees to be broken down into pieces for piling into windrows.

Jungle felling—chain method

The specifications of the snatch, lead and felling chains are as follows:

(*a*) Length of main felling chain (approx.), 300 ft.
(*b*) Length of snatch chains, 15 ft.
(*c*) Diameter of lead chain, 2½ in.
(*d*) Weight per lineal foot, 40 lb.

(*e*) Diameter of felling chain, 3½ in.
(*f*) Weight per lineal foot, 62.5 lb.

Physical features

(*a*) *Type of jungle:*
The dry zone forest plant association can be termed ' Hemicyclia-Vitex-Chloroxylou ', with *Hemicyclia sepiaria, Vitex pinnata* and *Chloroxylou swietenia* in predominance. Where the soil is quite rich the plant association has such dominants as *Terminalia arjuna, Melia compsita* and *Alstonia scholaris.*

(*b*) Tree population per acre (average), 200.

(*c*) Root systems: cover both shallow and deep anchorages.

(*d*) Diameter: 6 in. to 18 in.; some 3 ft. to 4 ft.

(*e*) Height: 60 ft. to 70 ft.; a few go up to approximately 100 ft.

(*f*) Soil type: variable, hard and poor, deep, easily worked.

(*g*) Topography generally: flat, undulating, with rocky hills.

(*h*) Water table: average, 20 ft.

Machine protection

(*a*) The tractors are fitted with substantial steel belly protection plates, to which are attached the towing hooks.

(*b*) Robust radiator protection.

(*c*) The radiator sides are protected against intrusion of branches.

(*d*) Canopies are of heavy construction, having a wooden decking covered with steel plate supported on appropriately heavy stanchions.

(*e*) As additional head protection the operators wear steel or bakelite helmets.

Production

(*a*) *Felling:*
Rate of accomplishment per machine-hour: 1 acre.
One jungle felling team consisting of six tractors has an hourly capacity of 6 acres.

(*b*) *Piling:*
Piling operation is a slower process; the rate per machine-hour: 0.5 acre.

Piling machines are fitted with dozer blades or forward-mounted rakes and pile timber into windrows on the contours wherever this is feasible. This is a punishing operation on such action groups as tracks, clutches and transmissions.

Selection of road vehicles

(*a*) *Topographical.* — From which may be determined such important technical factors as the capacity of the power unit, overall gear ratios, maximum speeds, tyre sizes and general specifications covering the chassis.

(*b*) *Climatic.*—Which will determine the type of cab and other factors affecting drivers.

(*c*) *Selection of the type of power unit.*—Diesel or spark-ignition engine.

(*d*) *Roads.*—Scope of construction and maintenance policy, with particular reference to surface maintenance, river crossings, maximum permissible axle loadings.

(*e*) *Distances* over which stores are required to be moved, quantities and relative data regarding the movement of personnel.

(*f*) *Restrictions* (*Governmental*) regarding carrying capacity and the relative regulations concerning axle loadings and body dimensions; if these considerations are permitted to influence us to the extent that we are precluded from purchasing the best type of vehicle, then this is a matter that should be taken up at the higher levels.

Basic to this problem are:

(*a*) Punishment given the vehicles by the road surfaces.

(*b*) Punishment given the road surfaces by the vehicles.

The lighter vehicle with its lower adhesion and higher maximum speeds, particularly when considered as factors affecting the road surface when running empty, are the primary causes of the rapid development of corrugations. The soils are highly plastic and the road surface rapidly becomes modified into a series of sharp corrugations, especially immediately following rainfall. The influence of light loading and higher speeds may be clearly seen—the left-hand side of the roads outwards from stores are relatively free from severe corrugations; the side carrying the returning unladen vehicles is severely ' wash-boarded '. The penalty paid for poor roads is inescapable —low vehicle serviceability factors, high repair costs, substantial losses due to down-time, top-heavy vehicle and personnel establishments etc.

The future

The preference for the heavy crawler-type tractor for earth-moving applications and first tillage operations on virgin lands is slowly yielding place to the wheel tractor in the 200-h.p. classification.

Tribute is paid to the ' crawler ', to its magnificent past and to current achievement and to what it will do in the future before its day is done. The scientist and engineer are, however, moving towards placing the power

Photo: International Harvester Co.

A crawler tractor, fitted with a bulldozer, engaged in road making

behind the earth-mover on to wheels, thus achieving a twofold main purpose —elimination of the steel track system, with its multiple wearing parts, and its replacement with pneumatic-tyred wheels, whereby a greater extractive potential from ' mechanisation as a prime accelerator' will become possible.

Drawing from current experience—with both types over a diversity of applications—it is my view that 75% of land development and earth-moving work generally could be accomplished with the ' big wheelers ' at higher rates of accomplishment and lower cost. The most effective earth-moving teams I have are groups of ' overhung ' type motorised scrapers push-loaded and generally supported by wheel-dozers. Good haul roads, sound co-ordination and manipulative competence, haul speeds of 20 m.p.h. and high spreading velocities, these accelerate earth-moving to a pitch of speed and rhythm undreamt of a few years ago. The ' crawler ' tractor and trailing ' bucket ' scraper as an earth-moving unit may still have its purpose under certain specific operational circumstances, but it will be a diminishing usage.

An Aveling Barford shuttle dumper for transporting soil. Reversible drive controls enable the machine to drive straight away where movement is restricted

Standardisation

Standardisation has advantages, particularly in the procurement phases of operations. Simplification of store-keeping resulting from standardisation is advantageous to the store-keeper, but in the wider significance there are factors which should be taken into account. Are we to give greater consideration towards simplifying the work of procurement officers, scales engineers and store-keeping personnel generally, or concede that the requirements of a scheme as a whole demand primary attention? On a development scheme of any magnitude standardisation on one make of primary equipment breeds a sensitivity to conditions which may adversely affect the production of manufacturers supplying that equipment, or they may, for reasons outside our control, become temporarily inaccessible.

Whatever the conditions might be which may adversely affect production or accessibility, it is unlikely that these would apply equally or simultaneously to a number of suppliers of similar equipment. Where the countries of origin also vary, the spread of risk becomes sufficiently wide to make the dangers from adverse developments a reasonable chance. Whatever might be said to the contrary, where all or most of the business is placed with one supplier there will inevitably be a lessening of interest in the user's needs, leading to a lowering of service efficiencies. The presence of competition in the field should tend to sustain the interest of the supplier in the needs of the user.

Sound policy

The age in which we live is governed closely by technological factors. Indeed, we live in what may be termed a ' technocracy ', in which the touch of the machine has ' altered all created things '. In such an age, therefore, it is important to ensure that educational procedures will establish a sound relationship between sociological and cultural considerations and the technical demands levied upon a people.

At present it would appear that the educational system in vogue tends to direct those of the higher intellectual standards into academic occupations and those of lesser ability into industry and agriculture. It is becoming increasingly evident to me as an engineer that in manipulative skills many Asians surpass comparable groups in other countries within my experience, but in comprehension of the technical character of work they are relatively backward. Limitations of certain educational procedures can contribute in no small way to the creation of a ' management void ' lying between the workman and higher levels of administration. The numbers of those who are competent to fill the posts of foremen and works managers are at present small, and until this gap is bridged technological advancement will continue to be impeded.

These are features which give cause for concern. There are large concentrations of mechanical equipment abroad, much of which is not yet deployed and that which is at work is not fully extended. From the point of view of agricultural economics, the situation is complicated, in that deficiency in skilled management can reduce this machinery to a state such as would bring embarrassment and possible menace to the cause which we are endeavouring to serve. Mechanisation, to be sound, must be slow and planned to a scope scaled to those limits defined by existing proficiency standards and expanding only as these improve.

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IRRIGATION OF AGRICULTURAL LANDS WITH WATER FROM DEEP WELLS

G. H. PARR, A.M.I.E.E.

(*Sumo Pumps Ltd.*)

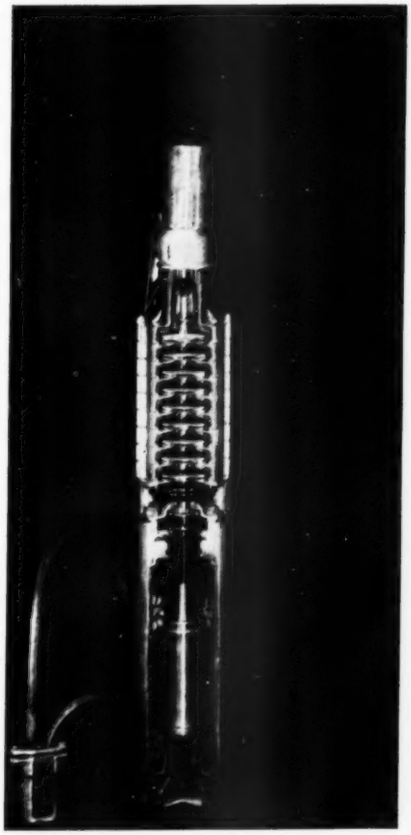
In arid regions it is sometimes possible to obtain irrigation water from subterranean sources during periods of drought. The first problem is to locate the water, the second is to bring it to the surface, the third is to put it to effective use, so as to conserve the supply.

IRRIGATION of agricultural lands is, of course, widely practised in various parts of the world, but the source of water is in nearly all cases a river or lake. There are, however, large stretches of country, particularly in tropical and sub-tropical areas, where there are no perennial rivers and where all forms of surface water dry up in the hot weather, just at the time when most needed for irrigation purposes. It generally happens, however, that even in this type of terrain there exists water at greater or lesser depths underground in the form of water-logged or water-bearing strata, fed from some more distant source, or replenished by rain falling on the outcrop of the particular strata. The problem is therefore twofold: one of determining whether or not underground water is available in waterless localities which are otherwise suitable for crop growing, and then having located the water to get it to ground level and distributed so that crops can use it.

As is well known, irrigation can pay handsome dividends, increasing the yield of suitable land from one crop a year to two, and in some cases three crops a year, and in other areas providing one or two crops on land which previously grew nothing at all because of lack of water. Examples of irrigation from deep wells occur in many areas of southern Africa, northern Africa (including Egypt and the Sudan), India and Pakistan and northern Australia.

Underground water sources

A great deal of information is available for nearly every region of the world, dealing with the question of underground water. Information can usually be obtained from the local Geological Survey Authority, local Health Authority or Public Works Department. Other well-informed sources of information are the local well-drilling firms, the larger of which usually have a practical geologist on their staff. A further source of information sometimes available is from the geology department of a university in the territory.

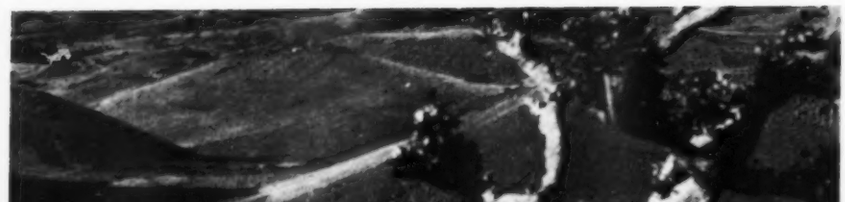


A small Sumo pump in section showing details of pump and electric motor

A geologist with some practical experience of the particular area can be relied upon to find a spot where wells and boreholes will strike water, if underground water is known to be present, usually without the aid of hazel twigs. It should be emphasised that it pays to get expert advice first, otherwise the sinking of a well or a borehole which remains dry is a costly failure.

Wells and boreholes

The sinking of wells and boreholes is a skilled trade. Firms of borehole drillers are located in most territories, and there is an increasing number of British drilling concerns taking an interest in overseas drilling. Some of them have set up overseas subsidiaries, particularly in British territories. Wells can, of course, be hand dug and can be any size from 3 ft. to 20 ft. in diameter. It is usually cheaper, however, to employ a firm who, by using percussion or rotary drilling rigs, can put down a small-diameter borehole, from 6 in. inside diameter to 12 in. or 18 in. inside diameter, according to the water output required. These may either be lined with steel tubes, or left unlined or partly unlined according to the particular strata. Apart from supporting the borehole walls in unstable strata, the lining tube can also be positioned in order to exclude unwanted sources of water, *i.e.* some strata may contain brackish water or, in the case of wells intended for drinking-water supplies, the lining tube can



A sugar-cane plantation in East Africa irrigated with water from a deep well

be used to seal off contaminated water sources, allowing pure water to be drawn from remaining water horizons in the lower strata.

The size of the well to be drilled, and its depth, depend upon many factors and expert advice is necessary in each case. In assessing the probable yield of a well or borehole the amount of water required for the particular irrigation scheme in mind must be considered and, in some instances, it will be necessary to obtain the water from a number of boreholes, suitably spaced apart, depending upon the permeability of the particular strata from which water is to be drawn and the potential reservoir of water available at each borehole or well site. Many boreholes and wells, of course, yield surprisingly large quantities of water, but particularly in arid or semi-arid regions the underground water supplied may be scanty and trouble at a later date with both the pump and the borehole may arise should over-pumping take place.

Deep well pumps

There are several types of deep-well pumps, from the old-fashioned bucket or piston pump, which is comparatively inefficient, to the more modern types of vertical spindle pumps and submersible pumps. The vertical spindle pump has the actual pumping part at the bottom of the well, driven by a very long vertical spindle from an electric motor, or a diesel or petrol engine, at ground level. The submersible pump, on the other hand, has both its electric motor and the pump down at the bottom of the well and therefore saves the wear in a large number of bearings all the way up the well, and it also saves a considerable amount of time when the pump has to be raised and lowered. On the other hand, the submersible unit must be electrically driven and, if mains supply is not available, a petrol or diesel generating set must be provided locally.

Both the vertical spindle type and the submersible type of pump can be designed to give any required output of water at whatever head is necessary. In assessing the total head which the pump has to develop, it must be remembered that the pump must be capable of lifting the water from the lowest water level in the borehole vertically up to the highest point at which water is required plus whatever pressure is required at the nozzles in the case of spray irrigation schemes, plus an allowance for the hydraulic friction in the pipework. If local advice is unobtainable, the pump manufacturers will always give advice on the best size of pumping unit, and on pumping and irrigation schemes generally, providing the user will supply full information about the site conditions.

Household supplies

In areas where drinking water is scarce and electricity not available an irrigation scheme may be combined with a scheme to provide modern amenities. For instance, a generating set will be necessary to operate the electric pump because no mains supply is available; so during the evenings and at other times, when the irrigation pump may not be working, the same generator can provide electricity for lighting and other household requirements. Similarly, the underground water can also be pumped to storage tanks to supply the household and farm buildings. Generally, underground water is of exceptional purity, the strata through which it passes acting as a filter, but if the quality of water is suspect for some reason or other it can be passed through filters and, if necessary, softeners before passing to the household taps.

If long periods of running are envisaged, particularly during the irrigation season, it is obviously better to operate the pump off the public supply mains, if at all possible. All modern types of pumping equipment will operate 24 hours per day, if need be, without any trouble at all, but a private generating set might have to be duplicated to restrict the number of hours of daily running of individual engine sets to something reasonable. A further disadvantage of private generating plant is, of course, the necessity for dismantling for overhaul at intervals. Where private plant has to be employed, it is usually necessary to work to a rigid schedule so that the engine sets are only dismantled and out of use when the irrigation water can be dispensed with and when sufficient water can be stored to cover household requirements for the necessary period of time.

Irrigation schemes

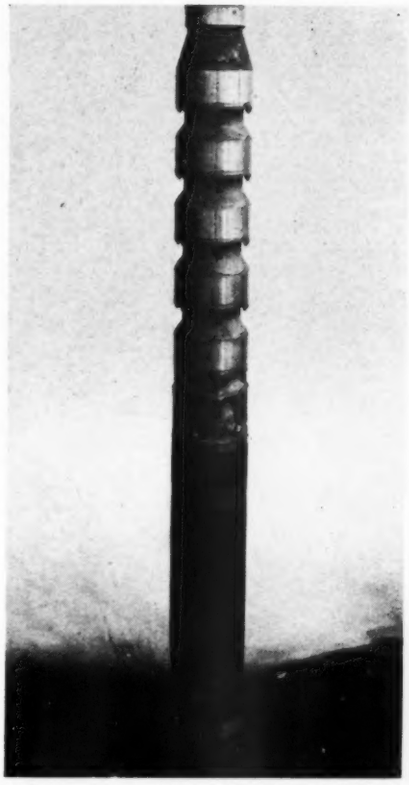
In some cases, depending upon the nature of the land and the particular crop to be irrigated, the water discharged from the pump delivery main can be distributed by suitable channels simply by gravity flow. This method is widely adopted for a great variety of plants from citrus trees to nurseries of young roses. The water requirements are calculated from the required number of acre/feet per growing season for the particular plant, translated into gallons per day or hour, to be supplied by one or more pumping units. It has the merit of simplicity, but some intelligence is required in the opening and closing of the irrigation channels to ensure that all parts of the irrigated

land receive the proper amount of water.

Sprayers and rainers

The other widely used method of irrigation is by powerful sprayers. Spray equipment is of several types and ranges from a relatively simple fixed overhead pipe installation to powerful rotary sprayers. The fixed overhead piping systems are generally used for intensive market garden plots of no very great extent. A variation of this is rocking or oscillating spray lines, which ensure rather better distribution of the water spray.

The method most popularly used for spray irrigation is the rotary sprayer or rainer. With this type of equipment the nozzle and the body to which it is attached are free to rotate in a suitable stand and in operation provide a sweeping curtain of water droplets over a considerable area. In some types the motion is purely rotary, but other types of spray equipment have been devised where the nozzle sweeps over a sector only, the size of the sector usually being adjustable at the sprayer and the nozzle sweeps backwards and forwards over the chosen sector. It must be remembered when planning spray irrigation schemes that a considerable pressure is required *at the spray nozzle*, and this pressure must be allowed for in calculating the total head which the pump is required to develop. In some installations where there is a combination of a very high pressure at the sprayers, coupled with water at a considerable depth below ground level, it has been found more convenient to divide the pumping into two parts by providing a deep-well pump to lift an ample supply of water to a suitable tank at ground level and a high-pressure pump to take water from the tank and deliver it to the spray nozzles.



A large Sumo submersible pump which is lowered to the bottom of the well or borehole

Fertilisers and insecticides

Although high - pressure spray nozzles may be a more expensive way of delivering irrigation water, very successful experiments have been carried out in many parts whereby liquid manures or insecticides have been added to the spray water at the appropriate time in the growing season. Another dual-purpose scheme, completed some years ago, provided for a considerable network of distribution piping with conveniently placed outlet hydrants. According to the requirements, water could be fed by hose from the hydrants to selected irrigation channels supplying water to the fruit trees, but at times when pests were prevalent a trailer-mounted pump (similar to a fire trailer) was brought up and connected to the nearest hydrant as it moved over the land, the pump on the trailer providing a high-pressure jet enabling insecticide to be sprayed on the fruit trees. It will be appreciated that schemes can be devised to cover all aspects of irrigation and general water supply, but it is urged that landowners and others interested need to get in touch with experts to get the best results for a given expenditure.

Photos by courtesy of Sumo Pumps Ltd.

The Great Drought

Another drought has hit the American Great Plains, it is reported by U.S.I.S., parching land from deep in Texas and New Mexico, Oklahoma, Colorado, Kansas and Nebraska and, in places, north to the Canadian border.

Drought in this semi-arid region is not a new occurrence. But this one, now in its sixth year, is particularly bad. Men who reconstruct weather history from tree rings—narrow rings for dry years, wide rings for wet periods—say it is the worst for 700 years.

In contrast to the 'dust bowl' of the 1930s, when tenant farmers fled the sand, farmers this time refuse to leave. Most now own the land and pride of ownership, or whatever it is that keeps men tied to the soil, makes them stay and fight it out. Much land ought to be kept unploughed in the Great Plains, kept in grass that holds down the soil and protects it against the sweeping winds.

People in the Great Plains realised the seriousness of the present drought cycle for the first time in 1953. They tried to fight it, but the drought kept ahead of them. So that they can at least hold their own, cattle raisers have been selling more and more land to buy feed until the rains come. Farmers have taken jobs in industry to tide them over the dry spell.

In 1954 the Federal Government instituted an emergency relief programme and has since spent millions of dollars to expand credit, provide inexpensive feed, supply technical assistance for conservation and make food available to hard-hit farmers.

Millions of acres have become vulnerable to wind erosion. Estimates are that 25% of the land ought to be returned to pasture.

The big problem is how to fight the drought. There have been suggestions that the Government should buy up the land to restore it to grass. Land and water management specialists are considering laws directing the proper use of land. There have been suggestions that the individual States should induce farmers to change their methods.

Better methods of conserving underground water and rainfall, control of wind and water erosion, change in farming systems, of livestock and range management and for turning land unsuitable for tillage into pasture are all being reviewed. Recent blizzards bringing heavy snow have done something to alleviate the drought, but the position is still serious.

SPRINKLER IRRIGATION

The economic use of water in agriculture

IN his opening speech at the Sprinkler Irrigation Conference, held recently at Bournemouth, Mr. C. S. Wright, who presided, said, ' Farmers have always used water to help them reap a harvest from the soil, but not always skilfully or efficiently. Sprinkler irrigation has now brought the use of water to the highest degree of efficiency.

' The new science of sprinkler irrigation', he said, 'was based on knowledge of soil physics, plant physiology, biology, chemistry, engineering, economics, and agriculture. The user of a sprinkler irrigation system needs to know something about the crop, the root zone of the plant, the wilting range, the wilting point, crop needs, evaporation rates and application rates '.

The Conference was attended by many representatives from overseas; the various papers presented and the ensuing discussions have been published, and copies of the Sprinkler Irrigation Manual may be obtained from Wright Rain Ltd., who were responsible for the arrangements. The following is a brief summary of selected papers:

Sprinkler Irrigation by Prof. Winston Strong (Fresno State College, California, U.S.A.).

(a) Its status and position

Rich virgin soil in the Western States of America often became barren as a result of erosion caused by unintelligent farming and even less intelligent irrigation. Uncontrolled flooding wasted enormous quantities of water, and at the same time the damage to soil structure, due to the excessive application of water, was soon recognised as an acute problem.

Sprinkler irrigation, with its economical use of water and controlled application rates, became essential. Irrigation techniques are improving daily and the research work now being carried out on seed germination, tilth improvement, and frost protection by sprinklers shows that they have much to offer agriculture. Sprinkler irrigation can never be a substitute for good farming practice but it can, and will, make better farming possible.

(b) Its uses and advantages

Unlike surface irrigation, sprinkler irrigation will give a very even rate of application and the rate can be suited to the infiltration rate of the soil. This avoids puddling, leaching, and run-off which are common with other forms of irrigation. There is also a considerable saving of water, which means that a given quantity can be used to irrigate a much larger acreage, or alternatively the size of the reservoir, if used, can be much smaller.

Water is well known to be an essential plant nutrient. Higher yields of agricultural crops can generally be obtained if water is applied at the right time, in the right way, and in the right amount. Too much water can, however, be as harmful as too little.

Ordinary surface irrigation requires considerable movement of valuable top-soil to level off high-spots and to fill in low-spots, to slope fields for furrow irrigation or to build basins. Considerable erosion also takes place, even with the strictest control of water and the cumulative depletion of the fertile top-soil can make rich farmlands barren in a few years.

Sprinkler irrigation completely eliminates this erosion and disturbance of top-soils; it makes possible the full use of the land because there is no need for irrigation canals and supply ditches and because rolling lands can be easily watered by sprinklers. Soil crusting, which can delay plants from reaching the surface, is avoided and seed rotting in water-logged soil is eliminated. Sprinkler irrigation does not assist the spread of pests and weeds, as does canalised irrigation.

The soil can be kept open through the reduced application of water, and its structure will remain unbroken; soluble fertilisers can be applied in very dilute solution with the applied water. A dry soil can be irrigated into a condition which will make it possible to carry out mechanical cultivation operations in dry weather, and

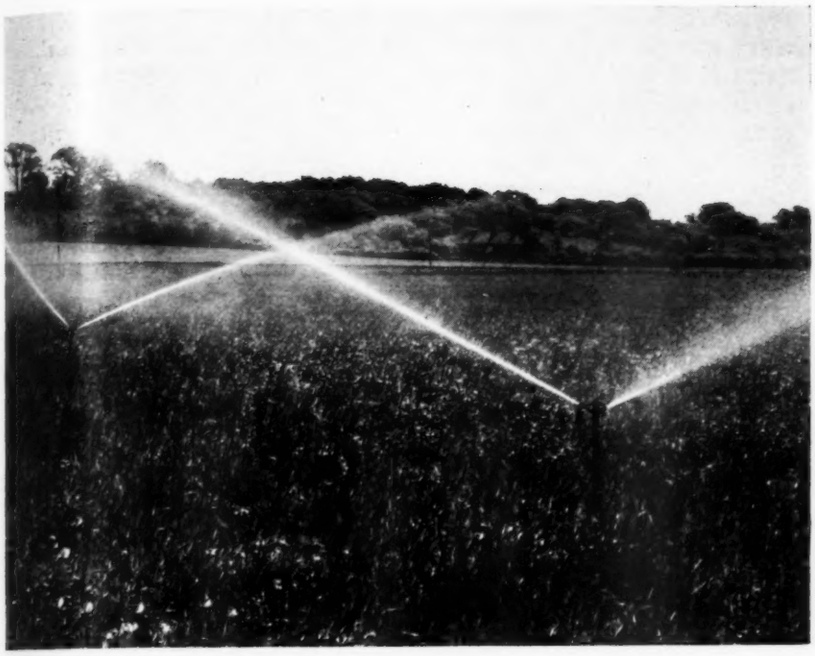
there will be no need to wait for the soil to dry to a ploughable condition after sprinkler irrigation. If a root crop has to be lifted, a small application the day before will assist the operation and will reduce damage.

The equipment can be moved from field to field with very little labour, and it can be used for a variety of crops merely by changing the height of the sprinklers.

(c) Water quality

When judging the quality of water for irrigation, it is necessary to consider the amount of dissolved salts in the water and the nature or composition of these salts in relation to their effect on crop production and soil condition. Thus a high concentration of salts is quite dangerous, whilst a concentration of chlorides, sulphates, or boron is usually toxic to plants. Large quantities of sodium in relation to calcium and magnesium usually results in soil puddling, or capping.

Hard waters are more suitable for irrigation purposes, since hardness reduces soil puddling; soft waters, particularly if the sodium percentage is high, are not usually suitable for irrigation. There is a wide variation in the tolerance of different crops to dissolved salts, but it is not always possible to set limiting values. These are discussed for boron, calcium, magnesium and for sodium, and also the sensitivity to sulphates and chlorides. It is considered important to deter-



mine the nitrogen content of irrigation waters, as this could have a bearing on the fertiliser programme. The pH must also be known because this determines what crops can or can not be grown.

(*d*) *Irrigation frequencies and reservoir concept*

The water intake of the plant will vary according to the kind and age of the plant, the type and depth of the soil, the climate and season of the year, and the cultural practices followed. Water will enter and move through the soil at rates which vary, depending on the soil type and its structure and the kind of crop being grown.

A method of determining the infiltration rate is described. The essential factor is to apply water at a lower rate than the slowest infiltration rate. Rates of application of one-quarter to one-half inch per hour have been found adequate for many agricultural soils. Heavier soils or soils on slopes may require lower applications; fast rates of application, even on soils that can take it, may not be the best; slower application rates permit the use of small diameter piping, which is easier to move from field to field. Minimum rates of application will vary from 0.1 in. per hour in cool climates to 0.2 in. per hour in hot climates. Under windy conditions application rates may need to be increased at least 0.1 in. per hour.

Where the soil or the soil profile is varied, the application rate should be less than the lowest infiltration rate found on the land being sprinkled.

Various methods of determining the water-holding capacities of a soil are described and there is a table which gives the water-holding capacities of different types of soil and the recommended application rates for each.

The amount of water available in the soil and the daily uptake by the plant determine the frequency of irrigation. Peak use occurs during the seed and fruit-forming period, which ordinarily coincide with the warmest period of the growing season for the particular crop concerned.

(*e*) *Seasonal peak use*

Plants in different climates and at various stages of development use water at different rates, and the amount of transpiring leaf area, exposed to the sun influences the amount of water used. Many plants have their highest water requirements during the fruiting and seed-forming periods, and the plant needs an adequate and uninterrupted supply throughout these periods to produce quality and highest yields.

A table is given which shows that the amount of soil water removed per day with peak use under various climatic conditions varies between 0.1 in. for a cold, humid climate and 0.3 in. for a hot, arid climate. Winds have the effect of increasing the amount of water required by perhaps as much as 50%.

Another table shows the average peak moisture use for common irrigated crops under cool, moderate and hot climatic conditions, and for dry and humid conditions. The figures range from 0.15 in. for market garden crops in a cool dry climate to 0.35 in. for corn growing in a hot dry climate.

Water Supplies for Sprinkler Irrigation by C. S. Wright (Wright Rain Ltd.).

The source, quantity and quality of the water supply has to be considered before a sprinkler irrigation system can be planned. Sprinkler irrigation makes possible the utilisation of even small flows of water, and it is not necessary to have access to a broad flowing river or a vast lake or reservoir, before such irrigation is possible.

The measurement of the flow of water in streams or small rivers is easily carried out by the use of weirs, and the correct design and procedure are described.

The use of water stored in ' tanks ' or reservoirs offers great possibilities, especially where summer supplies of water are limited. The requirements for the sound construction of such reservoirs are listed.

Water Supplies of Great Britain by Dr. S. Buchan (Geological Survey and Museum, London).

The first obligation of a statutory water authority is to provide water for domestic needs, and these needs must be met before considering the requirements of industry or agriculture. A single farmer using water for ordinary canalised irrigation might require a quarter of a million gallons a day for a part of the year—a supply adequate for the needs of a small town.

Riparian rights are discussed. These permit people to draw water from a stream provided that substantially the same amount of water is returned in the same condition as it was taken out. This may make difficulties for those who wish to abstract water from a stream for irrigation purposes, since the water sinks into the soil and it is also transpired by the plants. A neighbour could start a legal action to have his supplies restored.

It might be necessary to purchase water from the existing water authorities, or as an alternative, parliamentary powers might be obtained to make available large quantities of water for agricultural purposes, and to impound

and store this water on a large scale. There is also the possibility of water being found in the workings of old mines and in water-bearing strata, otherwise known as subterranean waters. These have increased in importance as sources of water during the last fifty years, particularly in south-east England.

The Water Act of 1945 now controls the use of such underground waters. This Act requires that those who wish to abstract ground water in certain areas must obtain a licence and prove that in abstracting water on his own land he is not depriving his neighbour of his supply. If an objection is lodged, the Minister decides whether the applicant may proceed with his plans.

To sum up, if a farmer is conveniently situated near a stream, pond or lake, he may be able to make use of this water, provided no established user complains; where the supply is limited, it is necessary to make sure that the supply can be maintained in the dry season when it is most required.

Soil, Moisture, and Plant Growth by E. R. Hoare (National Institute of Agricultural Engineering).

The effect on a loamy soil of bombarding it with drops of water of different sizes, falling by gravity, has been studied. In the case of the 0.5 mm. drops, the surface seems but little changed and, however long this process continues, the crumb structure does not alter appreciably; in the case of 0.75 mm. drops the crumb structure begins to change—the smaller particles of soil mix with the water and there is some clogging of the space between the particles. In the case of larger particles this process is hastened. When 2 mm. droplets are used, then the soil breaks down rapidly and the porosity of the soil at the surface is greatly reduced. This process is referred to as ' capping '. With 3 and 4 mm. droplets, the soil is not only flattened but moves under the impact of the droplets. In fact the capping can be so severe that the underlying soil is not altered at all. The effect of this capping is to reduce the infiltration rate and the ingress of water becomes more slow.

Another conclusion of importance to the irrigation engineer is that a heavy soil must be treated more carefully than a light soil as the latter shows less reduction of the infiltration rate for all droplet sizes. On light soils lower pressures can be used or the water can be thrown further; or more water can be applied in a given time. On heavy soils the reverse is the case.

In conditions of high sunshine, there is a passage of moisture from the soil through the plant to the atmosphere. If the rainfall is not greater than the amount of water lost by the plant, then the upward water movement will cause an increased salt content in the upper layers of the soil. If too much water is used, then the ground water table rises.

Thus with continued water loss at the surface, this salt concentration increases, and causes deleterious growth of the plant. The more water applied, the greater the risk. It is probable that the irrigation schemes of the Mesopotamian valley fell into decay because of these salting factors. Irrigation should not be embarked upon unless suitable drainage or soil water movement can occur so that the salt concentrations can be kept low.

Because the sun and water give high rates of growth to plants the balance between magnesium, potassium and nitrate may not be correct and often as soon as irrigation has commenced, deficiency problems are met.

Soil, Plant and Weather Factors in Irrigation by H. L. Penman (Rothamsted Experimental Station).

If a soil is thoroughly wetted and left to drain for a period of one or two days it comes to an equilibrium water content known as the ' field capacity '. With a soil at field capacity, natural processes of evaporation and transpiration remove water from the soil, either from the surface or from around the roots, so building what is known as a ' soil moisture deficit '. It is convenient to express this in terms of rainfall. Any water added in excess of this deficit will be surplus to requirements.

The rate of water use is measured for a fresh green cover of vegetation, short and actively growing, and never lacking water. This is known as the ' potential transpiration '—the condition aimed at in the ideal irrigation system.

Plants tend to root more deeply in light soils of low water-holding capacity, and less deeply in heavy soils of high water-holding capacity. To some extent, then, plant habit tends to annul differences between soils i.e. the total

A sprinkler mounted on a 15-ft. tripod. This is particularly suitable for crops such as sugar-cane, bananas and coffee

Orchard irrigation with low-angle sprinklers. These sprinklers keep the water stream low, thus avoiding the foliage

available water in the root zone tends to be an essential characteristic of the plant and this is sometimes called the 'root constant'. One of the objects of controlled irrigation must be to keep the soil moisture deficit less than the root constant.

An account is given of irrigation experiments, carried out in collaboration with the British Sugar Corporation on two commercial farms. In a dry year the need for irrigation was obvious, but in a wetter year, which expert farming opinion regarded as wet enough, there were appreciable responses to irrigation based on meteorological observations and computations of the potential transpiration on which the instructions were calculated.

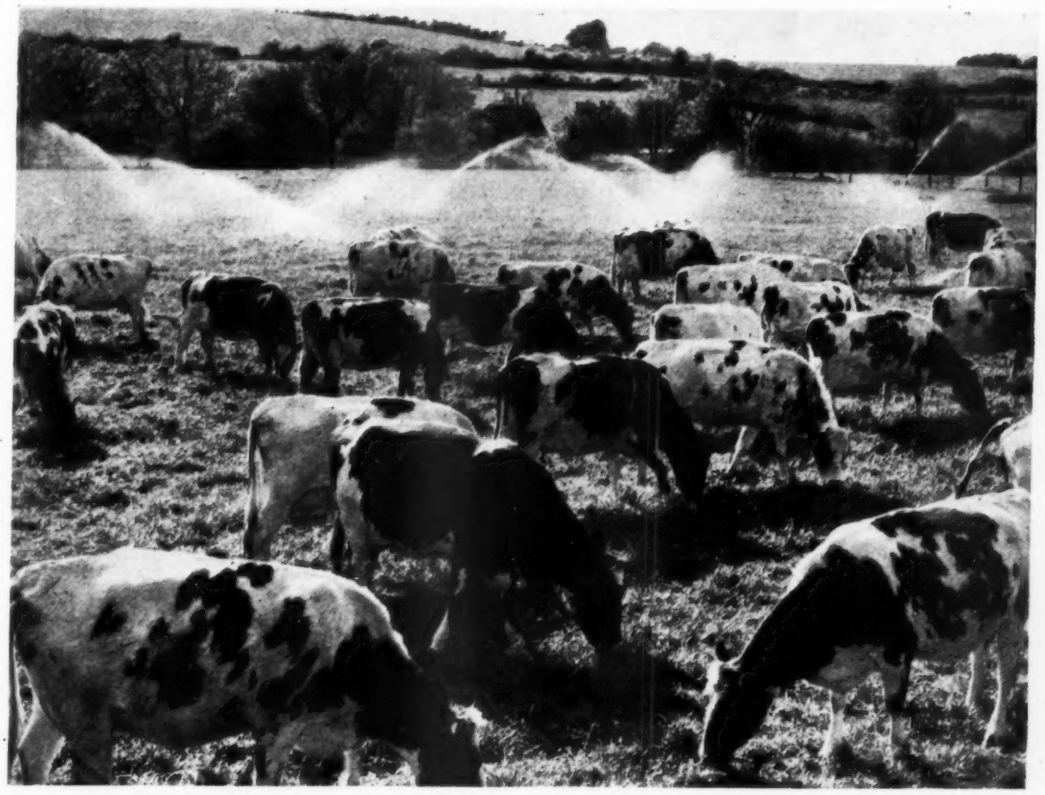
The Influence of Soil Moisture-holding Characteristics on Sprinkler Irrigation Design by D. G. Shockley (U.S. Department of Agriculture).

An account is given of the moisture holding capacities of soils of different texture. The range of capacity of the same type of soil may vary by 50% and the extreme variation between different soil textures may be as much as 400 or 500%.

The next factor considered was soil depth and the closely associated factor of crop root zone characteristics. Effective soil depths may be limited by bedrock, a cemented hardpan, or a heavy claypan and the presence of a high water table.

Thus a coarse-textured sandy loam with a depth of 4 ft. will store as much water as will a medium-textured loam with a depth of only 2 ft., i.e. they will furnish the same amount of water, provided that the crop has a root system that can utilise the full depth of the coarser soil.

A table is given of the normal root zone depths of mature irrigated crops growing in deep permeable, well-drained soil. This includes pastures and legumes, cereals, and horticultural



A herd of cattle grazing with sprinklers in operation in the background

and orchard crops. From this it can be seen that many annual plants and certain perennials have root zones of 2 ft. or less, and that only a relatively few irrigated plants develop roots and utilise soil moisture from depths greater than 6 ft.

About 40% of the total moisture extracted from the soil by the crops comes from the top quarter of the root zone, 30% from the second quarter, 20% from the third and 10% from the bottom quarter. Shockley's study had also indicated that when all of the available moisture (from field capacity to wilting point) has been removed from a fourth of the root zone profile, the plants usually will be unable to extract sufficient moisture from the remaining root zone area to maintain vigorous growth during periods of maximum transpiration. Thus for most soils, irrigation will be needed when the top quarter moisture has been used up. From this it is possible to compute the total extraction of moisture in the root zone.

The paper concludes with a discussion of methods for estimating the seasonal and monthly consumptive use values and the irrigation requirements of various crops. From this it is possible to determine the peak period irrigation frequency or the minimum interval between irrigations. These are essential factors in the design of a sprinkler irrigation system.

The Calculation of Irrigation Need by L. P. Smith (Meteorological Office).

Calculations necessary to determine water requirements bewilder the farmer and something simpler is required to assist him to avoid the evils of too little water and too much water, and of too early watering and too late watering. Water must be given at the right time and in the right amount.

A series of monthly charts are given showing the water requirements for various zones of the British Isles in terms of 'days per inch'. Thus in April in the Home Counties, green cover plants would use just over 1 in. of water in 17 days; in Scotland it takes 22 days to do the same thing. In May, with warmer weather, comparable figures are 10 days in southern England and 14 days in north Scotland.

Thus, if the rainfall that has fallen during these periods is subtracted, it is possible to determine how much water needs to be added by irrigation; if much rain has fallen in any interval and the total of 1 in. has been exceeded, obviously no irrigation is necessary.

Determination of Humidity

Members of the Tintometer Ltd. and the Department of Scientific and Industrial Research have collaborated to produce a simple method of measuring humidity. It is equally suitable for determining humidity against surfaces which may not be in moisture equilibrium with the atmosphere, for example, concrete floors, and for atmospheric humidity in small spaces or crevices.

Specially impregnated papers (produced by the British Drug Houses Ltd.) are exposed for two hours in the atmosphere to be measured. The paper is then transferred with forceps and immersed in a vessel of liquid paraffin to prevent any further change in colour. The colour of the paper is then assessed against the colour standards provided in the Lovibond Comparator disk.

Since the colours of the paper vary somewhat with temperature, the matching should be done, if possible, at the same temperature as at the site where the paper was exposed, or else with the papers at approximately 20° C., which is the temperature at which the colours of the glass standards were matched. If the temperature at which the matching is done differs appreciably from 20° C., the allowance to be made can be worked out from a table provided with the apparatus. When care is taken a high degree of accuracy can be obtained.

COCONUT STUDY GROUP

Inter-governmental talks between major coconut-producing and consuming countries have taken place in Colombo, Ceylon, and the meeting recommended the setting up of an FAO Coconut Study Group.

Following its discussions, the meeting listed the six chief problems needing study on an international level.

1. Trends in the demand and supply of coconut and coconut products.
2. Instability of prices and international trade.
3. Terms of sale in international markets.
4. Problems of quality and grades in international trade.
5. The improvement of statistics on the world coconut industry.
6. Study of processing techniques.

The Bentall-Hayter 5-ft. mower harvesting Napier grass in East Africa. This machine is especially suitable for African conditions, as it will deal with the tallest veldt grass, star and love grass, rapoko, coutch, as well as napier, lucerne, sun-hemp, and even light scrub

WATER FOR THE CROPS OF SOUTH AFRICA

New irrigation schemes to secure higher yields and ensure more stable conditions for agricultural production in South Africa are discussed in a special report by Barclays Bank D.C.O., which has some 600 branches in that country. This report on the irrigation problems of this vast area shows how the special problems of the arid regions are being overcome.

THE schemes chiefly discussed in the report envisage more water for more than a million acres. It is pointed out that South Africa is, on the whole, a dry country, averaging annually only about 17½ in. of rainfall and subject to freak years and heavy loss by evaporation in high summer. With no natural lakes for inland storage, most of the water flows off in fast-moving streams to the sea.

In these circumstances, says the report, it is of paramount importance not only to conserve water by constructing dams and artificial lakes, but also to utilise the country's water as far as possible to irrigate suitable, but at present arid, land and thus to extend the very small total area that is at present under intensive cultivation and also to provide water for industrial and domestic consumption.

The irrigable areas

Hydrographically, there are five or six different drainage systems. The more important are the Orange–Vaal and Limpopo–Sabi; the south-eastern coastal area, extending from the Limpopo southwards to the Great Fish River in the eastern Cape; and the southern system, which includes the important Gamka–Gouritz basin.

On the upper Orange River, up to its confluence with the Vaal, there are few places where good level ground and suitable dam or weir sites are in reasonable proximity. And here only about 2,600 morgen* of land, including some 1,000 morgen in the Caledon River basin, are under irrigation.

It is estimated that some 10,000 morgen are potentially irrigable downstream between the confluence and Prieska, but actual irrigation development along the main stream here, too, has been inconsiderable to date.

From Prieska to about 20 miles below Upington, the Boegoeberg Dam commands extensive stretches of land on both banks. Above Upington about 4,800 morgen are under irrigation, whilst four fairly distinct irrigation areas—in all some 13,200 morgen—lie below Upington down to the Aughrabies Falls.

Further along the gorge tract there is very little scope for irrigation development, although small areas are being irrigated. Along the Sak River—the western headwater of the Hartebeest River which flows into the Orange below Kakamas—a 'sowing dam' system is practised.

Accordingly, it is generally accepted that only a small area is suitable for irrigation in Orange River Valley itself and that only about one-tenth of the river's water resources can be utilised profitably in its own valley. This does not mean that the water cannot perhaps be used in other basins; and two tentative schemes with this object have been evolved.

*A morgen = 2.116 acres.

The main weir at the Olifants River irrigation scheme in the Northern Transvaal, where more than 300 native families make a good living growing wheat and other crops under irrigation, helped by European and native agricultural officials

Sand-Vet scheme

The Sand–Vet development scheme, already begun, proposes damming the Sand River at Allemanskraal and the Vet at Erfenis, eventually irrigating some 13,000 morgen. An extension also proposed is to divert water from the Caledon River, through tunnels near Ficksburg and Maseru, into the Vet and Sand basins. It is estimated that about 70,000 morgen along these two rivers could be irrigated in this way.

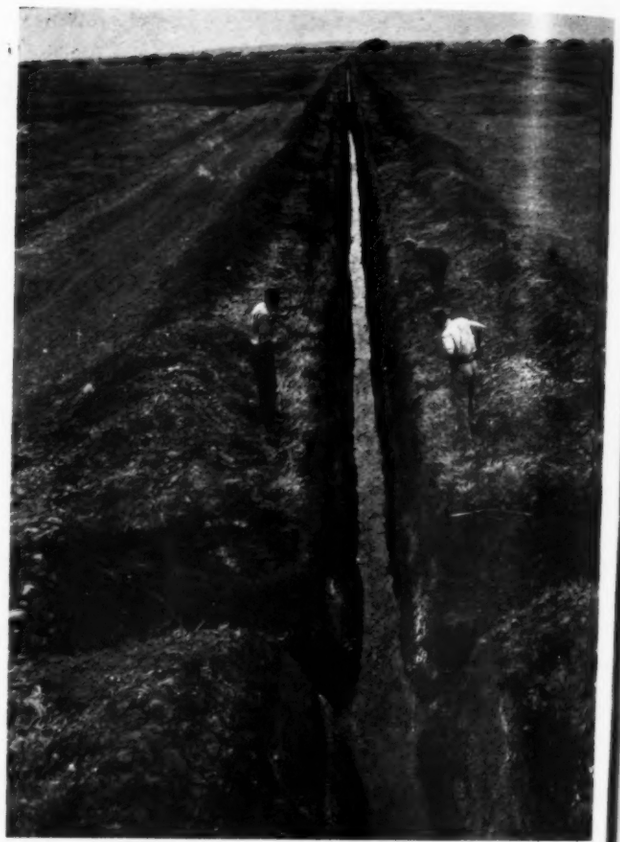
Orange-Fish-Sundays scheme

The second scheme, a very far-reaching one, the Orange–Fish–Sundays diversion project, is being considered by the Government. It proposes to divert about one-tenth of the flow of the Orange River from a diversion barrage at Doornport, near Venterstad, through a 50-mile tunnel under the Kikvorschberge into the Great Brak River, the headwater of

the Great Fish River. It is estimated that this could increase irrigated land in the main Fish and Sundays valleys to about 275,000 morgen.

Vaal-Hartz scheme

The largest scheme in the Union is the Vaal–Hartz, in which the Vaal Dam, about 23 miles upstream from Vereeniging and just below the confluence of the Vaal and Wilge Rivers, is linked with the Hartz River valley to the north-west of Fourteen Streams. Water from the dam is allowed to flow 360 miles down the Vaal to a diversion weir at Fourteen Streams, whence it is taken into the Hartz River valley through a cut two miles long and 34 ft. deep. Total irrigation here is about 43,000 morgen, of which some 10,000 morgen lie in the Taungs Native Reserve.



Part of the drainage system carrying excess water from irrigation land at Taungs; the water is eventually used again. This is a part of the Vaal-Hartz scheme, irrigating some 43,000 morgen, of which some 10,000 morgen are in the Taungs Native Reserve

Other irrigation schemes

Irrigation use of the Limpopo system is confined mainly to its headwaters. Crocodile and Marico Rivers and their tributaries, the Elands, Hex, Sterkstroom and Aapies Rivers, irrigate about 26,000 morgen, the biggest dam being the Hartbeespoort on the Crocodile in the Magaliesberg range, irrigating 15,000 morgen around Brits.

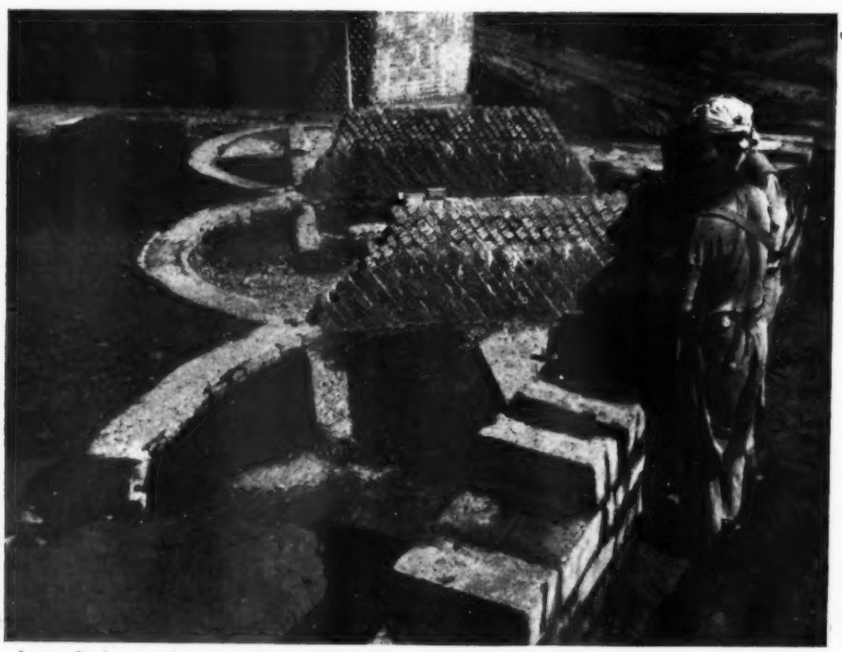
In the Olifants River basin the largest irrigated area borders the main stream in the Bushveld, where 11,500 morgen receive water from the Loskop Dam. There are several other schemes in the basin with a further 18,000 to 19,000 morgen under irrigation.

Larger schemes exist along the Gompies tributary, where some 2,700 morgen of citrus groves of the Zebediela Estates are irrigated, in the Steelpoort and Ohrigstad valleys, and in the eastern Soutpansberge, where a new dam on the Njelele River provides water for 2,500 morgen of European holdings.

The Tugela River is probably the largest in the south-eastern coastal drainage system, but lacking suitable land, only about 7,000 morgen are irrigated. In contrast, lack of water is the main handicap in the important Gamka–Gouritz basin of the southern system, but irrigation development has nevertheless been far more extensive here than in the Tugela basin.

In the face of ever-growing consumption of water for all purposes, says the Bank's report, the Government is fully alive to the need for adding to its conservation measures.

The Department of Water Affairs now has some 20 major schemes on hand, primarily affecting agriculture, with an annual expenditure of about £5 million.



An arched-type dam at Vlekpoort, Hofmeyr, in the Great Fish catchment area some miles to the east of the projected Orange-Fish-Sundays diversion. Such dams at regular intervals catch silt and in time bring dongas and sluits up to the level of surrounding ground

[The rivers and tributaries mentioned in this article are all to be found in The Oxford Atlas, published by Oxford University Press, page 75.]

Photos: South Africa House.

High-quality Groundnuts for Direct Consumption-II

Cultivation and Marketing

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In the second part of his article Mr. Oram discusses fertiliser and cultivation methods for groundnuts in Libya. He reviews present grading and marketing methods and concludes with a discussion on possible research and mechanisation problems

FERTILISER investigation has been mainly concentrated on finding the optimum level of the three major elements, the most interesting result being the effect of nitrogen; significant responses were obtained in six out of nine trials, in five of which the increase was linear over three levels.

Phosphate, on the other hand, has only increased yields in one instance at the highest level of application and if applied in the absence of nitrogen has frequently depressed output, whereas potash has given very inconsistent results.

In a rotation trial wheat yields after groundnuts have been reduced by 50% compared with yields after fallow, although the groundnuts were adequately fertilised, and it has been remarked that this effect can be due to removal of large quantities of potash by the groundnut crop.[4] Tripolitania farmers at present apply very heavy dressings of phosphate and potash to groundnuts, and it may prove more economical to apply these elements mainly to other crops in the rotation and reduce direct application to groundnuts.

There is some indication of differential response to fertiliser between the Virginia and Valencia groups of varieties, and this and many other aspects of fertilisation, including the effect of organic manures, require further investigation.

Since nitrogen appeared to be so important and many farmers use it as top-dressing, this practice has also been examined and has resulted in increased yields in every instance (see Table 2).

The figures quoted for quality represent the analysis of produce of one trial only and must be treated with reserve. It appears, however, that top dressing is beneficial, since number and weight of sound pods per kg. sampled, shelling-out percentage and average weight per pod are all higher from top-dressed seed, and the percentage increase of one-seeded pods is more than offset by a marked reduction in percentage abortion, suggesting that many pods which might otherwise have aborted formed at least one sound seed following top dressing. These results are contrary to experience in the U.S.A., where heavy nitrogen dressings are believed to delay maturity and reduce quality and shelling-out percentage, although the evidence was very conflicting and it was concluded that the problem required further investigation.[3] Significant responses to nitrogen have been obtained in South Africa,[5] and it is probable that where organic matter is low, and soils prone to excessive leaching, profitable results will be obtained from the application of nitrogenous fertilisers to groundnuts.

Cultivation methods

Planting distance.—The questionnaire showed average row spacings on farms to be 36 cm. for the Tripoli white-seeded variety and 31 cm. for the red variety, with seeds planted at 20 cm. and 16 cm. respectively in the row. However, practice varied widely from a maximum combination of 60 × 20 cm. to a minimum of 25 × 10 cm., and it was therefore considered important to establish the optimum spacings. Trials clearly show the importance of close spacing both of rows and of seeds in the row; for instance, in 15 cases out of 16 spacing of seed at 10 or 15 cm. resulted in higher yields than 20 or 30 cm. (see Table 3).

Close planting appears particularly important for the Virginia group, which have shown a much lower germination than the Valencia type (see also Table 4).

Close spacings are now recommended in many other producing countries to counter losses from disease, but, unfortunately, the optimum row distance of 30 cm. determined for Tripolitania is unsuited to mechanical cultivation. This is, there-

TABLE 2
EFFECT OF NITROGEN TOP-DRESSING ON YIELDS AND QUALITY OF GROUNDNUTS

	Yields of dry pods, quintals/ha.					*Percentage of total containing*				*Total No. of sound pods per 1,000 g.*	*Total weight sound pods per 1,000 g.*	*Average weight of 100 sound pods*	*Shelling out, %*	*Aborted pods, % of total weight*
	Trial					*seeds*								
	1	2	3	4	5	1	2	3	4					
Basal nitrogen* only ..	43.4	22.4	7.9	12.9	39.0	10	88	2	0	374	695	18.6	69.0	25.5
Basal + top-dressing† ..	46.5	27.1	20.7	14.5	40.2	20	79	1	0	457	865	18.9	72.0	13.0
Increase	3.1	4.7	12.8	1.6	1.2	+10	−9	−1	0	+83	+170	+0.3	+3.0	−12.5

* Basal application = 2 quintals of ammonium sulphate per ha.
† Top-dressing = 2 quintals eight weeks later.

Fig. 5.
(a) *Untreated field showing heavy weed infestation.*

(b) *Effective weed control by pre-emergence spraying with pentachlorophenol*

fore, being recommended for the smaller farms, which offer little scope for mechanisation, and experiments are continuing to find the best system for large-scale production. Samples have not been taken for assessment of quality from different spacing combinations, and this will be done in future. However, experiments in French Equatorial Africa suggest that close spacing (40 cm. × 15 cm.) produces nuts of superior quality to those spaced at 40 cm. × 80 cm., since the former are formed mostly around the base of the plant.[6] Furthermore, it establishes a better initial population with fewer gaps. This has an important bearing on quality, since farmers replant the gaps in order to obtain maximum yields and the later-sown plants delay the lifting of the whole crop and tend to produce a high proportion of ' pops ' and poorly filled pods. It is therefore desirable to reduce replanting to a minimum.

Weed control

Irrigated culture favours massive weed growth and unweeded trial plots showed yield reductions of 50% in 1954 and 66% in 1955 compared with hand-weeded controls. Quality is also affected, since maturity is delayed and many pods are poorly filled. Herbicides which show promise in experiments are pentachlorophenol (4 gal./ acre with diesel oil) and 2,4-D ester (4 pints/ acre). Good control of the main broad-leaved weeds lasts about five weeks after pre-emergence spraying with no damage to the crop. This saves at least one hand weeding and gives a good start—very important in the production of an even quality nut. Post-emergence spraying with MCPB and 2,4-DB is also a possibility, since the crop appears to tolerate these compounds quite well. However, a good herbicide is urgently needed to control grasses and sedges—notably *Cynodon dactylon*, *Digitaria sanguinalis* and *Cyperus rotundus*. These weeds are a serious problem and where they are prevalent none of the formulations mentioned above will be an effective substitute for early and thorough cul-

TABLE 3
TRIALS CONDUCTED ON ' LOCAL WHITE ' STRAIN

Spacing, cm.	*Percentage of production of the average for each district* = 100										
	Sidi Mesri		*Bianchi A*			*Bianchi B*		*Olivetti*	*Zavia A*	*Zavia B*	*Miani*
Rows Seeds	1954	1955	1953	1954	1955	1954	1955	1954	1955	1955	1955
30 × 15	113	107	109	—	110	—	110	—	116	—	—
30 × 20	104	103	—	89*	79	111	94	131	101	102	119
30 × 30	98	—	104	112	—	101	—	—	112	—	—
40 × 10	—	—	—	—	—	—	—	—	—	102	—
40 × 15	107	99	—	—	122	—	106	—	100	—	—
40 × 20	92	95	—	—	85	—	90	77	96	—	114
40 × 30	87	—	—	—	—	—	—	—	93	—	—
50 × 10	—	—	—	—	—	—	—	—	—	108	—
50 × 15	—	102	—	—	—	—	—	—	125	—	—
50 × 20	—	92	—	—	—	—	—	90	75	89	95
50 × 30	—	—	—	—	—	—	—	—	80	—	—
60 × 15	98	—	102	—	—	—	—	—	—	—	—
60 × 20	107	—	—	132	—	98	—	—	—	—	74
60 × 30	90	—	85	67*	—	95	—	—	—	—	—
Average, %	100	100	100	100	100	100	100	100	100	100	100
Production average, quintals/ha. ..	24.0	44.5	28.9	20.3	19.0	24.2	52.7	22.4	21.5	34.9	12.7

* Bianchi A—1954, plots affected by eucalyptus plants; figures cannot be relied upon.

TABLE 4
TRIALS ON GERMINATION OF DIFFERENT VARIETIES

Trial	*Total number of plants to 100 sq. m.*		*Number of diseased plants*	
	Local White	*Local Red*	*Local White*	*Local Red*
1	865	1,090	30	15
2	805	865	9	0
3	805	990	42	21
4	950	1,140	Not counted	
5	960	1,180	,, ,,	

TABLE 5
CLASSES OF TOLERANCE

	Extra	*Standard*	*Mercantile*
I. Shape and aspect of nuts; deformities..	0.5%	2%	15%
II. Admitted percentage of one-kernel pods	1%	4%	15%
III. Maturity and development of kernels, taste	1%	4%	10%
IV. Traces of insect and/or mildew, mound, etc.	Nil	2%	5%
V. Colour and external and/or internal discolouring and/or spots, originating from late harvest, either on husks or kernels	Nil	5%	20%
VI. Extraneous substances	0.50%	1%	3%
Grand total of tolerance for classes I to VI inclusive admitted for each quality	2%	10%	30%
VII. Humidity	6%	6.5%	7%

tivation, either by hand or machine. Effective control by cultivation is closely linked to correct planting distance and this poses a difficult question, since, although wide rows facilitate weeding between, close spacing helps to produce a dense population which acts as an effective smother later in the season. Probably a wide row with very close planting in the row to reduce the gaps which fill up with weeds will prove the best solution for the larger farm. (see Fig. 5.)

Seed treatment

This might also assist in quality production by reducing early losses and reducing the percentage of replanting. Trials of seed dressings have so far proved rather disappointing, probably because all seed is hand-shelled and most of it is hand-planted, whereas the most striking benefits from chemical seed treatments have usually been noted where mechanical handling was the rule.[7] Results correspond somewhat to those obtained in the Congo Basin,[8] fungicides based on thiram and captan having given the best results, but in Tripolitania mercurial compounds depressed yields below the untreated control in nine experiments out of ten, although the differences were not always significant.

A wide field of investigational work remains, particularly in fertilisation, control of disease, the development of rotations which are both sound and profitable, water requirements and irrigation practice.

However, a reasonable start has been made within the limited resources available to a small country and an active extension campaign is being conducted by U.S.O.M. and Government Extension Officers to make the results known to the farmer.

Grading and marketing

Selection of a suitable variety, correct planting, sound seed and control of disease and weeds can do much to ensure good quality and even maturation. Valencia types tend to sprout in the ground when ripe and delay also increases the risk of having to lift in wet weather with consequent mould and discoloration of produce. Rapid methods of lifting are therefore desirable for the larger grower. Mechanical lifters which windrow the crop, followed by carting and threshing (Fig. 6), have given quite good results with a loss of only about 4% in threshing, compared with hand-picking, but combining has given rather disappointing results and depends greatly on even maturity. Since few farmers have driers or grading machines, the ultimate quality of the produce has until recently depended greatly on the integrity of the merchants who buy, grade and ship the crop. There have been a few unfortunate instances of low-grade produce being exported, and for this reason export standards were introduced in 1954 at the instigation of the Tripolitania Agricultural Produce Export Committee.[9] These provide for three standards—' Extra ', ' Standard ' and ' Mercantile '—with minimum tolerances as shown in Table 5.

There is an optional grading accord-

Fig. 6. Machine threshing groundnuts in Tripolitania

ing to number of nuts to the ounce for the 'Extra' quality only, and 'Mercantile' allows a higher toleration under item V, provided nuts are otherwise healthy and sweet. Varieties must also be true to type with minimum diameter of 15 mm. for the 'Tripoli 2' and 12 mm. for the 'Tripoli 4' type, as shown by sievings. The grade must be specified on both sack, label and shipping documents; all produce submitted for export is inspected by Government inspectors and no shipment failing to comply with its standard can be exported. Although initially unpopular, the producers now realise the importance of these standards for their own protection and are so anxious to co-operate both with the authorities and amongst themselves to maintain a high-quality product that a suggestion to allow certain specified sub-standard produce out was turned down at their representative's request.

Future developments

Research problems.—Yields have risen steadily over the last 10 years. In 1947 the average was quoted as 1 ton to the hectare (cwt./acre); at present it is almost 2 tons and good farmers are obtaining 3 tons. To maintain yields at such a level is essential to cover the high costs of irrigated culture in a country with no surface water, and this will require constant vigilance against disease, degeneration of seed and loss of soil fertility. In this connection many problems require solution and as short-term investigations into straightforward aspects of crop improvement bear fruit research will be concentrated increasingly on more fundamental problems, such as irrigation requirements, the use of rotations and organic matter to maintain fertility, and the control of disease. In examining the results of future experiments much greater attention will be paid to factors affecting quality, and yield alone must not be the chief criterion.

Mechanisation.—For farmers with more than a few hectares, mechanisation could reduce costs considerably, because hand labour is not cheap on a cost/efficiency basis and casuals tend to be unreliable. One farmer had 100 labourers lifting his crop in November 1955, a heavy shower fell on the dry farming area inland, and next day all but 20 had left to sow their barley. However, the family farmer who can give close supervision to his few permanent workers is likely to obtain higher yields than the larger growers, and if mechanisation is to be profitable it will need to be efficient and to be developed on a less haphazard basis than at present. Research facilities cannot cope with all the multiplicity of methods and machines that are possible and, since many farmers lack the capital to purchase costly machines without being certain of their efficiency, a very good field exists for enterprising manufacturers. In the past manufacturers or their agents have too often failed to convince prospective purchasers in machinery demonstrations because of inadequate attention to detail. The old maxim 'time spent in reconnaissance is seldom wasted' has been ignored; machines have been sent in unsuited to local conditions, poorly trained operators have not got the best out of them and elementary precautions indicated by experience elsewhere overlooked. A manufacturer having courage to bring a complete range of adequate equipment, with skilled operators able to meet and overcome new problems and to run it on a medium-sized farm throughout a whole season with frequent public demonstrations, would not only reap a reward from what is at present a very open field, but would also do the country a considerable service.

Grading and marketing.—The proposed establishment (with the assistance of the FAO marketing and co-operative specialists) of growers' co-operatives, with grading and marketing facilities, should assist the smaller farmer considerably, stabilise prices and improve quality still further, and co-operative oil presses will provide an outlet for sub-standard or surplus produce. The existence of such co-operatives will enable production to be planned to avoid overcropping and to maintain a rotation; the existence of oil presses will encourage this by providing an outlet for possible alternative crops such as linseed and sesame.

Farmers now realise the need for export standards and initial resentment has gradually faded as an 'export mentality' has developed.

The initial expansion of groundnut culture in Tripolitania has been a credit to private development; the Libyan Government is determined that it will receive adequate backing from the Administration in the future.

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Photos: Fig. 4, FAO; all others by P. A. Oram.

Logarithmic Sprayer

First announced at the British Weed Control Conference at Blackpool last year (WORLD CROPS, 1957, **9**, 73), the logarithmic sprayer has now gone into production and the machine is being made available commercially to research stations throughout the world. Fisons Pest Control Ltd. have placed an initial order with the Kestrel Engineering Co. Ltd. for 100 of these variable dosage sprayers which are used for the determination of optimum dosage for spray chemicals in field conditions.

There is considerable significance to be attached to this development, which, it seems, will ultimately supersede the laborious statistical plot method of making comparisons between chemicals and for determining the correct rate of application of herbicides, insecticides and fungicides in field trials in each zone of operation.

Hill Land Reclamation Scheme

This scheme has been operated in Counties Londonderry and Tyrone for more than eight years and in that period about 3,500 acres of rough hill land have been brought into production. The land is ploughed deeply and cultivated with special equipment provided by the Ministry of Agriculture. This work is carried out free of charge provided that the farmer undertakes to lime, manure and seed the reclaimed land to the satisfaction of the Ministry. By the end of the summer of 1957 about 4,250 acres will have been ploughed under the scheme and as most of the land suitable for reclamation has now been treated the scheme will soon have to be brought to a close.

Electrodusting

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This article gives an account of a new technique for applying protective dusts to plants, whereby the dust will adhere to both sides of the leaf and there is a higher degree of adhesion.

THE application of crop-protecting dusts in such a way that an electrostatic charge is imposed on the dust as it leaves the nozzle of a dusting machine is known as ' electrodusting '. The advantages of this new technique are:

1. Enormous reduction in the amount of dust required.
2. Greatly increased deposit of dust on the plant.
3. Even and uniform distribution of dust on the leaf.
4. Deposition of dusts on both sides of the leaf.
5. Greatly improved adherence of dust.

Underlying Principles

The mechanism of electrodusting, expressed in very simple terms, consists of agitating atoms to create an ionised field. An atom can be described as a nucleus surrounded by one or more shells of electrons; the numbers of shells and electrons determine the character of the atom. An electron is a definite entity (10^{-3} cm.) with a negative electrical charge. An atom is normally in a state of equilibrium, the total negative charge of the shell electrons being balanced by the total positive charge of the nucleus; the atom is, in fact, composed of both positive and negative particles. An atom can lose one or more electrons from its outer shell without losing its character. An atom which has lost one or more electrons is called an *ion*. By losing its electrons the electrical balance is upset and an ion is therefore positively charged.

Electrons can be stimulated by high voltage. If a very high voltage is applied to a point, a ' corona ' is produced around it. This corona is the visible manifestation of the radiation caused by energising the electrons. Free electrons are stimulated and large numbers of electrons are ' chipped ' off the atomic shells. Chemical changes occur in the ambient air, such as the formation of ozone and nitric acid (in the presence of moisture), accompanied by a hissing noise. A positive voltage gives rise to a blue ' glow ', whereas a negative charge causes a reddish-purple glow. A positive corona is uniform in appearance and a negative corona is ' tufted ' and is accompanied by greater production of ozone. These differences are due to the action caused by the different charges. With positive charging, the corona attracts the liberated electrons and the ions are discharged to an earth. If the H.T. source is centralised in an earthed cylinder, there is a constant flow of ions to the earthed periphery of the cylinder. By a suitable arrangement of points a uniform ionised field is produced. This is illustrated in Fig. 1, which is a photograph of the corona produced in the nozzle of an ' Agricola ' electroduster.

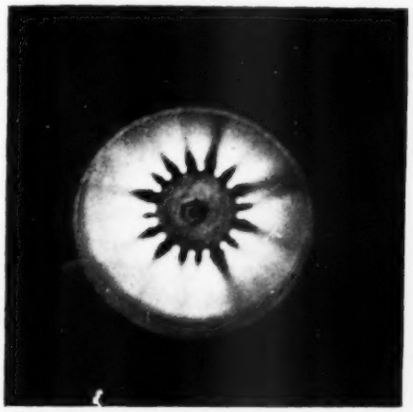


Fig. 1. This photograph of a corona clearly shows the completeness of the ionised field obtained with an ' Agricola ' electroduster, thus ensuring that all dust passing through acquires a change

Electrically-charged dusts

When a dust is blown through this ionised field it acquires the ions and hence becomes positively charged.

There are two basic laws which apply to such charged dusts, both of considerable importance. One is that ' like forces repel, unlike forces attract ' and the other that ' a charge induces an equal and opposite " mirror " charge equidistant and opposite from a conducting surface'. The strength of this force is inversely proportional to the square of the distance of the charge from the surface—the nearer to the surface the greater the attraction to the ' mirror ' charge. This, in effect, draws the charge to the surface with accelerating force and precipitates it there effectively.

When the dust is charged, as it goes out of the nozzle, each particle is equally charged and there is consequently no agglomeration and the particles retain their individual identities. As the dust cloud approaches a plant the charged cloud induces an electrostatic field in accordance with the law mentioned above. This electrostatic field consists of lines of force, similar to those readily visible in a magnetic field when surrounded by iron filings. The individual particles follow these lines of force and consequently are precipitated on both sides of a leaf. The force is greater than the opposing natural forces of speed, gravity, wind and the thermal barrier layer, which so effectively oppose deposition of ordinary dusts. Being equally charged, and mutually repelled, the particles are deposited evenly and equidistant from each other on the plant surface.

Finally, it has been shown that the plant is itself negative. It is found that when the dust is positive it adheres better than when negative and consequently in the ' Agricola ' Electroduster the dusts are charged positively. The adhesion is marked and the deposit is rain-resistant to a remarkable degree.

Laboratory trials

The effect of dust is important. Different types of dust have different dielectric properties and ionisation potentials, and different particle size ranges behave in different ways. Table I shows the different deposit values obtained from two types of dust, an

ordinary dust charged and uncharged, and an Electrodust charged by an ' Agricola ' Electroduster.

The photographs showing dust deposits on glass slides relate to these figures and bring out other points, especially the even distribution obtained with the ' Agricola ' Electrodust (Fig. 2). The normal dust used was one of the finest available commercially. These pictures demonstrate the importance of the dust used. The impressions were obtained from leaves dusted with Electrocoxydust containing 4% of copper as oxychloride and pressed between filter papers impregnated with rubeanic acid. The rubeanic acid reacts with the copper salt to produce a grey-green colour.

Field trials

Results in the field have been equally as good as those obtained in the laboratory. Tests have shown that deposits on both sides of the leaf in fungicidal and insecticidal quantities can be obtained at a distance up to 75 ft. from a small machine. Table 2 sets out the results of an experiment carried out in dusting an apple orchard at distances of about 60 and 65 ft. It will be observed that the deposits are higher on the under surface and this is due to the hairy nature of the under surface of apple leaves which attracts more dust than the smooth upper surface.

A great deal of work has been done but much more still needs to be done. In the meantime, the benefit of this research is already available in the ' Agricola ' Electroduster and ' Agricola ' Electrodusts, putting these advances at the service of the grower. There is little doubt that electrodusting represents a revolutionary step forward in the application of crop-protecting chemicals, although it is probable that some time will have to elapse before all the implications are understood and the new technique receives general acceptance in agricultural circles.

Table 1
(a) Total Deposit Both Surfaces

Dust	*Particle size*		
	2μ	4μ	6μ
Electrodust charged	35.2	11.0	7.0
Normal dust charged	27.0	8.0	4.2
Normal dust uncharged	16.7	2.3	0.9
Increase of 'Electrodust' over normal dust charged, %	30.4%	37.6%	63.8%
Increase of 'Electrodust' charged over normal dust uncharged, % ..	110.8%	378.2%	677.8%

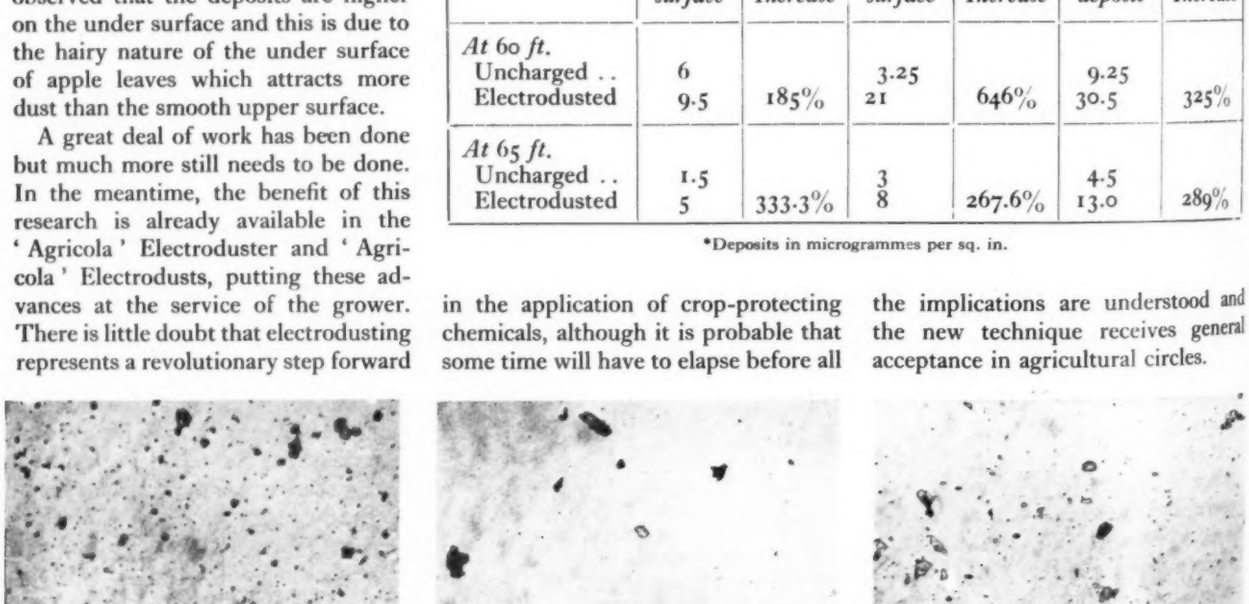
(b) Deposit on Reverse Side only

Electrodust charged	17.6	5.8	2.4
Normal dust charged	15.2	3.7	1.7
Normal dust uncharged	7.6	0.6	0.3
Increase of ' Electrodust ' over normal dust charged, %	15.8%	57%	41.2%
Increase of 'Electrodust' charged over normal dust uncharged, % ..	131.5%	866%	700%

Table 2
Comparative Trials in Apple Orchard in Strong Wind*

	Upper surface	*Increase*	*Lower surface*	*Increase*	*Total deposit*	*Increase*
At 60 ft.						
Uncharged ..	6		3.25		9.25	
Electrodusted	9.5	185%	21	646%	30.5	325%
At 65 ft.						
Uncharged ..	1.5		3		4.5	
Electrodusted	5	333.3%	8	267.6%	13.0	289%

*Deposits in microgrammes per sq. in.



Photos by courtesy of Prof. Dr. Ing. Gallwitz, Landmaschinen Institut, Göttingen

Fig. 2. Deposits obtained on a glass slide at 5 m.
(Left). *Electrodust electrodusted* (Centre) *normal commercial dust* (Right) *commercial dust electrodusted*

Storage of Apples

Meeting of the East Malling Research Station Association

THE storage behaviour of samples of Cox's Orange Pippin apples grown in England under widely differing soil and climatic conditions was under discussion at the East Malling Research Station on 27 February. An array of some 170 trays of apples, provided by growers in all the main apple-growing areas from selected and marked trees, were displayed with information about the orchards in which they were grown and their subsequent storage behaviour. The period of storage was five months.

At one end of the shed there was an exhibit of stored apples from the apple manurial trial at the research station. This showed the marked effect of a grass sward, under widely differing conditions and soil pH, sown in 1953, in improving the colour and appearance of the apples and in reducing losses through *Gloeosporium* rots in store.

Dr. F. R. Tubbs, the Director, pointed out how the investigation formed an essential part of collaborative work between East Malling, Ditton Laboratory, Long Ashton and the Imperial College of Science, aimed at prolonging the economic storage life of Cox's Orange Pippin.

Dr. Montgomery, who was in charge of the investigation, described how the apples were collected and put into cold storage at 37° F., and into gas storage at 38–39° F. with 5% carbon dioxide and 2½–3½% oxygen. This was done during the first week of October.

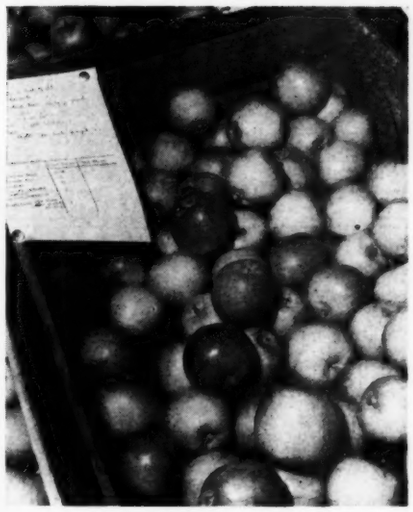
He briefly surveyed the orchard histories of the samples, drawing attention to the wide use of M.II root stock, grass swards and renewal pruning; captan had been used on over 50% of the orchards. There had been less rotting in cold store than last year, although in gas store, with one month's longer storage, the losses were higher. Some of the cold-stored samples showed an unusual form of low-temperature breakdown — a superficial browning of the skin in the early stages.

The fruit from Norfolk had kept excellently, with very few rots, as it had done in the experiments in 1954 and 1955. Various reasons for this were discussed without any final conclusions being reached. Losses by rots were higher on ' light ' soils and with low potassium applications and high nitrogen applications were associated with higher losses through flesh breakdown. There were more rots on fruit from old trees and the larger apples suffered most. It was possible that variants from the true Cox's were being grown and it was proposed to collect scion wood from certain of the worst and best samples to see if these characters were perpetuated.

He summed up by suggesting that for long keeping, Cox's should be grown on a medium soil, with a grass sward, and be fertilised with moderate nitrogen and adequate potash. The results show that moderate crops of medium to small apples keep best and that spraying with captan assists in controlling *Gloeosporium* rots.

Dr. Tomkins, Superintendent of the Ditton Laboratory, told growers that no suitable fungicidal vapour had been found to control rotting in storage, but that any chemical that appeared promising would be tested. Dr. D. Martin, a visiting research worker on storage problems from Tasmania, commented on the admirable co-operation between the growers and East Malling Research Station that had made this experiment possible. In Tasmania the light off-year crop was not considered suitable for long storage.

East Malling Research Station



Cox's from Norfolk, (above) *which kept extremely well*

Cox's from Kent, (left) *were not good after five months' storage*

Technical News

Articles in the May issue of other journals of the Leonard Hill Technical Group include the following:

Chemical & Process Engineering.— ' Manufacture of Fertilisers and Cattle Food from Blood ' by Dr. L. M. Hirchberg, ' Materials Handling in the Chemical Industry '.

Dairy Engineering.—' Rider Electric Vehicles for Delivering Dairy Products ' by W. E. D. Bell, ' Research on Foil for Dairy Use ', 'A New Crate Stacking Machine ', ' Care and Maintenance of Electric Motors in Dairies ', ' Production of Orange and Other Beverages by the Dairyman, Part 2 ', by G. B. Beattie.

Food Manufacture, which is a Mechanical Handling special issue, includes articles on ' Beverage Filtration Equipment and its Management, Part 2 ', ' The CO_2 Method of Stunning Pigs for Slaughter ', ' Handling in Milling and Baking ', ' Electronic Aids to Mechanical Handling '.

The Importance of Good Drainage

ALL plants need water—in fact, it has been described as the primary requirement of plant life—but the water should be moving and not stagnant. Surface water may not disappear quickly on some soils because either the soil is too close-textured, or the subsoil is impermeable, or the water-table is close to the surface. Agricultural land must not be allowed to remain waterlogged for too long.

The main object of artificial drainage on farm or plantation is to maintain an adequate concentration of oxygen in the soil atmosphere, so that the plant may develop normally. Excess carbon dioxide, too, which is respired by the roots and produced by soil micro-organisms, must be able to diffuse away freely from the root zone, or it will restrict growth. In some soils hydrogen sulphide may be produced under anaerobic conditions and, if allowed to accumulate, is toxic to most roots. Then there may be excessive or harmful concentrations of salts, which can only be removed by good drainage conditions.

Lack of proper drainage, when trees or plants are young, causes shallow rooting and poor development; the flooding of land, due either to choked drains or unsatisfactory outlets due to non co-operation from the owners of adjoining properties, will result in root rot and die-back in older trees, which will render them unhealthy and unproductive.

No drainage system can work efficiently unless the drains are regularly kept clear of fallen leaves, branches or leaf fronds and of silt, reeds or water grasses. Banks must be regularly repaired, accumulations of silt must be regularly removed, and a proper fall to the final outlet must be maintained.

A drain which is so choked with debris and silt that the water in it does not move is not doing its job; it must be regularly cleaned and maintained if the land it is serving is to remain healthy and productive, but with rising wages this work is frequently neglected because the damage that results is not immediately obvious. As a result drain cleaning is frequently neglected as a measure of false economy.

The new 'Sapper' ditching machine, manufactured by Bomford and Evershed, makes ditch maintenance cheap and easy, and the machine can be operated by one man, so replacing the gang of labourers normally required for this work, a particularly important point where agricultural labour is scarce. Its output, too, is high. Recently a ditch, 2 ft. 6 in. deep, running alongside a forest track was cleaned of 9 in. of silt and weeds at a rate of five chains per hour. Under specially favourable conditions it will do seven chains an hour.

The 'Sapper' ditching machine seen in action. With this machine ditch digging and maintenance is a one-man operation

Although it is designed to operate on either side of any ditch, its special application is for ditches which are accessible from one side only, as in the case quoted above, or a ditch adjacent to a hedge or beside a field of standing corn. It can also be used for cutting drainage channels in waterlogged meadows. It can be used to clean ditches between 6 in. and 6 ft. in depth.

The new machine is of solid tubular construction and it is controlled by a single acting hydraulic ram powered from a powerful tractor, providing yet another example of the successful application of hydraulics in agricultural machinery. It is simply hitched to the three-point linkage and hydraulic system of a Fordson, David Brown, Nuffield, McCormick International or any other tractor with sufficient power to meet its heavy requirements. The ditcher can be dropped off in a few minutes when the tractor is required for other work.

Essentially the machine consists of two triangular frames carried on a flat skid and with all of the side thrust taken by a flat disk wheel and none by the tractor; the latter is merely used to draw it forward and to operate the hydraulic ram, which in turn operates the scoop.

The method of operation is simple. The scoop is lowered to the bottom of the ditch; the tractor is moved forward a few yards until it is filled; then the scoop is raised clear of the ditch and the spoil is dropped beside the ditch or at any distance up to 9 ft. away. The scoop is then returned to the ditch for the next cut, the time for the complete cycle of operations under good conditions being only a matter of seconds.

The machine can be disconnected and dismantled for transport elsewhere by withdrawing a number of pins by two men in half an hour and it takes about the same time to reassemble it. It can be assembled to work either right or left handed, according to requirements, and this change over takes only 40 min.

There are two types of scoop: a skeleton bucket for spoil of high clay content and a hinged bucket for working with sloppy material to ensure that

(continued on page 212)

Reclamation of Sand Dunes in New Zealand

MANY thousands of acres of barren sandhills near Muriwai, New Zealand, are being transformed by the Forestry Department. They are becoming an asset instead of a national liability. More than 5,000 acres of dunes have been planted with *Pinus radiata*, and in 20 years the first of these plantations, which is already 60 ft. high, will provide valuable timber within a short distance of Auckland itself.

The twofold purpose of the scheme is to utilise New Zealand's vast areas of sandhill country (more than 250,000 acres) and to prevent shifting dunes from encroaching further on fertile farmland.

About 11,000 of the 40,000 acres of sandhills at Muriwai have been ' consolidated ' with marram grass (*Aminophila arundenacea*) before planting with *P. radiata*.

Consolidation

The sand dunes are consolidated in several stages. The sand blown off the beach is allowed to bank up against tea-tree fences. Spinifex is then sown on the banks. The inland dunes, which often extend as far as four miles, are then sown with marram grass. Usually most of this takes root, although fierce gales sweeping from the sea have been known to obliterate the work of days in a few hours.

When the marram grass has become established, lupins are planted and the area is left to consolidate. After five years the thickly matted grasses are planted with pine trees set at 8-ft. intervals. This used to be done slowly and painstakingly by hand, but recently a new American machine has been used for the job. It incorporates a disk cutter and plough and, with three operators, is capable of planting 5,000 seedlings per day.

Farmers with land bordering the sandhill area have a vital interest in the Forestry Department's work, for unless the dunes are planted they advance relentlessly inland and can move as much as several chains during a strong westerly wind.

Mechanised planting

The Forestry Department has been experimenting with mechanical sowers which will plant in a few hours what normally takes days or weeks by hand. There are two types of mechanical sower, a seven-man machine which sows three rows of marram shoots at a time and covers 35 acres a day, and a smaller three-man machine for the more difficult areas.

Most of the planting so far has been done at the end of the 35-mile beach, but, according to the Conservator of Forests in Auckland, it is intended to plant the whole area eventually. Mechanised planting is the key to future development of sand dunes. Using the old hand methods, Muriwai alone would take anything from 100 to 200 years. Now it should be possible to have the grass planting finished in 20 years, and with better machines and more men it may be done even sooner.

(Left) *A mechanical sower planting marram grass to stop shifting sands.* (Right) *A ' wandering ' dune achored by marram grass*

NEW PUBLICATIONS

Advances in Agronomy

Vol. VIII. Edited by A. G. Norman. Pp. 423. New York: Academic Press Inc. 1956. 70*s*. 6*d*.

A welcome feature of this volume of 'Advances of Agronomy' is the inclusion of Latin binomials, together with local plant names, which greatly increases its value to foreign readers. Emphasis is placed on soil management and fertiliser practice and six of the nine articles fall into this category. An account of 'Field Crop Production and Soil Management in the Pacific North-West' consists of a review of '11 major kinds of soil area' with detailed information of annual precipitation, mean January and July temperatures, natural vegetation and the main soil groups occurring in these zones. There are sections dealing with land management and cropping in these areas, and necessarily with this treatment the article reads rather as a catalogue, but there is much information which should be useful to the agronomist interested in this region.

A contribution on the use of anhydrous ammonia as a source of fertiliser nitrogen describes how it was first used on a large scale about 10 years ago in place of solid nitrogenous fertilisers, which were then in short supply. Subsequently anhydrous ammonia applied to the soil below the surface as a liquid under pressure has been found in most respects equal to or better than conventional nitrogen fertilisers, and it has the added advantage of being cheaper. Some useful figures are given for increases in crop yield with anhydrous ammonia compared with other sources of nitrogen, but the inclusion of a list of chemical plants producing anhydrous ammonia, together with those under construction and projected, seems hardly necessary, nor do the details concerning 'bleeding losses' when transferring from one tank to another seem to merit inclusion.

'Molybdenum as a Fertiliser' is a review of work on this trace element. The complex nature of molybdenum requirements by plants is emphasised by reference to legumes, in which it is required both by the symbiotic nitrogen-fixing bacteria and also by the host plant. The effects of soil type and levels of calcium, sulphur and phosphorus on the molybdenum responses of different crops is discussed; spectacular improvements of pasture legumes in South Australia have been maintained for 10 years following a single application of molybdenum at a concentration as low as 2 oz. per acre.

A contribution on soil testing gives an account of the techniques employed both in analysis of soils and also in presentation of results. Examples are given of the effect of previous cropping and management on soil nutrient status. The authors stress the importance of individual testing and recommendations for small areas rather than dependence on summary tables and area maps for determining desirable fertiliser applications. 'Mineral Nutrition of Corn' contains details of the availability of the major and some minor elements to maize. Distribution of the elements within the plant is also considered and there are sections on mineral deficiencies and the effects of fertilisers and soil moisture on growth and nutrition. 'Organic Soils' is an article on the types and origins of different peat soils, with reference to their agricultural potentialities and their mineral contents.

'Progress in Grass Breeding' reviews some of the latest published work in this field. An important point made by the author is that chromosome studies of some grasses in common agricultural usage reveal disturbing shortcomings in the taxonomy of many of the more important varieties. In another article some recent attempts to assess winter hardiness are reviewed. The author draws attention to the difficulties of obtaining reproducible results in such investigations and, though he mentions subsequent pathological effects, he does not consider the importance of the micro-organisms present in the soil in which plants and seeds are 'cold tested', nor does he refer to the work which has been done on this aspect of cold hardiness by Harper in this country. This is, however, an interesting contribution which should help those working on this difficult problem.

The chapter concerned with tall fescue, *Festuca arundinacea* (Schreb.), is an account of the remarkably rapid rise to favour of this species as a pasture grass in the U.S.A. Domestic consumption of seed rose from a few thousand pounds in 1940 to 35 million pounds in 1954. This increase in esteem is doubtless partly due to the ability of tall fescue to grow within a pH range 9.5 to 4.5. In New Zealand and Australia, on the other hand, the author points out that this species has been considered a dangerous weed and cattle poisoning, similar in many respects to ergotism, has been attributed to it.

R. L. LUCAS

Agrarian Reform and the Record of Israel

By A. Granott (translated by E. M. Epstein). Pp. 301. London: Eyre and Spottiswoode. 1956. 21*s*. 0*d*.

This publication, the result of long research and investigation of the tenets of land tenure, attempts to survey the principles that have guided the land policy of the Zionist Movement during the past 70 years. It is clear, on the first reading, that the author has succeeded in his task. The scope of the book is wide, for, in addition to sections on the 'Principles and Tasks' and 'The Process of Implementation' the author has devoted four chapters to trends in land reform outside Israel: in Eastern Europe, in the Mediterranean basin, in Asia and Latin America. These chapters contain the summarised results of the effects of land distribution and agrarian reform in over 30 countries.

The greatest interest centres on the final chapter, in which Prof. Granott surveys developments in Israel and presents an outline of the policy that ought to be followed in the future agrarian policy of the State. He stresses that the changes in the distribution of land are not in themselves sufficient, but that they should be accompanied by a number of additional widespread operations: economic and social reforms, technical and agro-technical improvements in the exploitation of the soil, a raising of living standards and the improvement of education and cultivation. He maintains that Israel is uniquely situated with respect to a solution of its agrarian problem. The land regime is characterised by three features: the complete decline of large and medium land ownership; curtailment of private ownership, which now only affects a fraction of the lands in the country; and a huge increase

of areas under public ownership.

The author has laid down the following principles to form a general framework for an Israel agrarian policy: (*a*) the central feature should be the concentration of lands in the hands of the community—all landed property to be vested in one body, namely, the State of Israel. (*b*) A legal enactment should be passed preventing any sale of lands by the State and the Zionist Organisation, which shall transfer their lands only under leasehold. (*c*) Two types of ownership should be created, namely, public and private (the area of private holdings is likely to remain very small!). (*d*) A law should be passed establishing one standard leasehold system in respect of all public land in the State. (*e*) It should be the purpose of the agrarian policy to safeguard the holding unit (its area should not decline below the point permitting the farmer to earn his livelihood and maintain the farm, nor should the holding rise above a level beyond the capacity of the farmer and his family to cultivate it). (*f*) Once the holding minimum is determined farmers should not be able to reduce it. (*g*) The avoidance of fragmentation of estates. (*h*) As one means of preventing fragmentation, land should not be divisible even on the death of the owner. (*i*) It will be necessary to abolish a number of legal institutions, such as *mesha'a* (an ancient institution of collective ownership of land) and the *waqf* (religious trusts). (*j*) A qualified authority should be appointed to raise the standard of agriculture and to supervise the rational cultivation of the soil by the people of Israel.

This volume has been well translated, is well annotated and contains many tables and a complete index. It will be of great value to all those interested in land tenure and agrarian reform.

J. EDWARD THOMAS

A World Geography of Forest Resources

Edited for the American Geographical Society by S. Haden-Guest, J. K. Wright and E. M. Teclaff. Pp. 736, illustrated. New York: The Ronald Press Co. 1956. $12.50.

This colossal work is a symposium on the world's forests, prepared by 34 authors and three editors, and is the result of international collaboration. Six chapters are devoted to forests and wood products and 25 to the forest situation and problems of particular regions. These regional chapters, with two or three exceptions, are the work of men who hold, or have held, positions of responsible leadership in forest administration, research or education in the countries with which they deal. The text has a vividness and authenticity that more than compensates for the diversity of treatment which is inevitable in a symposium of this kind.

In large part, the book deals with forests as the source of essential raw materials; it tells what these materials are and whence they come; it also considers the relationships of forests to rainfall and temperature, to relief and soils, and to human populations and their needs and desires.

There is a never-ending struggle between those who want forest lands for crops, flocks, mining and utilitarian purposes and those who would maintain and enlarge the forests to conserve water and to protect life and property against flood and erosion. On the one hand, also, there are those who believe that the forest should be treated as a plantation producing a maximum amount of the type of wood they want, the pace of production being forced by human action; on the other hand, there are those who think that the best result in the long run will be obtained, if natural conditions in the forest are disturbed as little as possible, and the forest, while encouraged by the co-operating hand of the silviculturist, sets the pace of timber production. This book provides a material contribution towards the solution of the immense problem of how to maintain forest yields in the face of ever-mounting and ever-changing demands.

It is abundantly illustrated, well provided with maps and diagrams and thoroughly documented and as such constitutes a valuable book of reference for workers and students in the fields of forestry, agriculture, meteorology, geography, soil conservation and ecology; it will be of direct practical value to politicians, to administrators, to industrialists, paper and pulp manufacturers and other consumers of the world's resources of timber; and for the layman who feels concern for the present and future of the world's natural resources it provides much food for thought.

F.C.C.

Virus Diseases of Brassica Crops

This book, No. 14 in the Report Series of the Agricultural Research Council, written by Dr. L. Broadbent, of Rothamsted Experimental Station, is the result of intensive research on the subject in Britain. Crops of cauliflowers and broccoli in many countries have recently suffered serious losses from virus diseases and it was largely because of anxiety in the industry in England that more research on these diseases was arranged, with a view to establishing practical control methods. The degree of control to be achieved by such measures as isolation and protection of seed beds, siting of crops and overwintering of seed crops is exemplified and analysed. The report will be of direct practical value to advisory officers and growers of cabbage, turnip, cauliflower, swede, brussels sprouts, broccoli and other brassica crops in all parts of the world. Published by the Cambridge University Press, price 15*s*.

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Experimental Husbandry

The second issue of this publication includes eight reports on the growing of arable crops and lucerne in Britain.

Two series of trials on the seed rates of spring barley show that there is no financial advantage for seed rates in excess of 1 cwt. per acre over quite a range of soil types. Experiments with winter wheat indicate that seed rates in excess of 3 bushels are not likely to give sufficient increases to be economic. These experiments and one other with winter wheat again emphasise the importance of adequate dressings of nitrogen.

Two reports on sugar-beet growing add to the already extensive information on this crop. A manurial trial on a heavy loam of high fertility showed that the optimum dressings of nitrogen were about 1 cwt. per acre lower than the generally accepted figure on the lighter soils, and considerably lower than many farmers are using on these soils. The heavier dressings did not increase the yield of roots, but gave more tops and in only one year did farmyard manure give a worthwhile increase in roots.

Experiments with seed potatoes from various sources and on the value of lime on the Yorkshire Wolds have not confirmed two commonly held beliefs. (1) There was no advantage in obtaining once-grown seed potatoes from a

different soil type, and (2) although considerable quantities of lime are used on the Wolds, the trials did not show any response to dressings of four types of lime.

Published by H.M.S.O., price 3*s.* 6*d.*

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The Trade in Natural Rubber

This booklet, compiled by F. R. Horridge, covers fully yet concisely all stages in the natural rubber industry from plantation to user. Beginning with a description of planting methods and plantation administration, it then deals with crop collection, grading, packing and shipment. The latter half of the booklet is devoted to an account of markets, their brokers and dealers, transaction terms and qualities. In addition, there is a section on market tendencies, features and factors, speculative buying and parity, with final comments on the development and the market effects of synthetic rubber.

Published by The Purchasing Officers' Association, 146a Queen Victoria Street, London, E.C.4, price 3*s.*

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OEEC Publications

Fertilisers, Production, Consumption, Prices and Trade in Europe and the United States, 1954–57, gives figures for production, trade and consumption of the three major plant nutrients—nitrogen, phosphorus and potash—and information on fertiliser prices for OEEC member countries. There is also a chapter on lime. For the first time the report includes information on the fertiliser situation in Spain and the U.S.A. Price 8*s.*, $1.25, 400 F. fr.

The Organisation and Rationalisation of Soil Analysis. The need for more food production and the necessity to make the best use of the available supplies of fertiliser has hastened the development of soil analysis services for farmers. As a result of a survey undertaken in 1954 by two experts of the methods used at various selected centres in certain European countries, a seminar on soil testing took place at Wageningen, the Netherlands, in October 1955. The programme covered all aspects of the subject in relation to advisory work, from the sampling in the field to rendering the manurial advice, based on the analysis, to the farmer. This publication includes the full text of the papers presented at the seminar, a summary of the discussions and the recommendations made there, and the final report of the experts who made the initial survey. Price 12*s.*, $2.00, 600 F. fr.

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FAO Publications

Processing of Cassava and Cassava Products in Rural Industries, by L. W. J. Holleman and A. Aten, Development Paper No. 54. This is an account of the methods of processing tapioca flour, the layout of factories, the examination of tapioca and tapioca products and the uses of tapioca in various industries.

Prices of Agricultural Products and Fertilisers, 1955–56, the sixth of a series of annual studies, covers European price movements and policies, prices of individual agricultural products and fertilisers and agricultural wages.

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Alabama Polytechnic Institute

Recent publications received include Bulletin 301, ' Response of Crops to Lime in Alabama ', which covers the effects of lime and lime requirements of different soils in relation to cotton, maize, pasture legumes, soil-improving legumes, grasses, alfalfa, sweet clover, caley peas, groundnuts and soya beans. Bulletin 302 summarises the results of fertility experiments with runner groundnuts and makes recommendations for the application of fertilisers and lime, the use of organic materials and the importance of rotations.

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Potash Review

Further communications received from the International Potash Institute, Berne, Switzerland, deal with the leaching extraction of potassium from the higher plants, inorganic manuring in silviculture, determination of the threshold levels of potassium deficiency in the soil and in the plant, and foliage symptoms as indicators of potassium-deficient soils.

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Agricultural Engineering Research

Volume 2, No. 1, of the *Journal of Agricultural Engineering Research* includes papers on ' A Load Vehicle for Tractor Testing ', ' A Drill for Plant Breeding Experiments', 'Some Aspects of the Control of Plant Environment: Part 2—The Control of Temperature and Humidity in Artificially Illuminated Rooms ', ' Automatic Mist Control Equipment for the Rooting of Cuttings ', ' Swath Harvesting: Part 2 —The Swath ', ' The Design of Field Experiments on Soil Erosion ' and ' The Motive Power of the Future '.

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Other Publications

We have received copies of the following publications:

Fruit, a review of world production and trade relating to fresh, canned and dried fruit, fruit juices and wine for the year 1955, compiled in the Intelligence Branch of the Commonwealth Economic Committee, price 5*s.*

Rotavation, published by Rotary Hoes Ltd. This useful illustrated publication gives an account of how rotavation works and its various applications for different cultivation operations and will be of interest to all farmers, market gardeners and nurserymen.

Annual Report of the East African Agricultural and Fisheries Research Council, 1955–56, including the reports of the Agriculture and Forestry, the Veterinary, Fishery, Marine Fisheries and Trypanosomiasis Research Organisations. Published by the East Africa High Commission, price African Shs. 3.

More Profit from Dairy Farming, an attractive pictorial booklet produced by Imperial Chemical Industries Ltd. suggesting ways of lowering milk production costs by growing and feeding more grass. This is a much simplified version of their earlier bulletin, 'Profits from Dairy Farming '.

Good Drainage

(*continued from page* 208)

it can be correctly placed without premature spillage.

The ' vital statistics ' of the machine are as follows: overall width, 12 ft. 6 in.; overall length, 17 ft. 6 in.; maximum height when in raised position, 11 ft. Its weight is 9 cwt. and the bucket capacity is approximately 1 cu. ft. and it is 9 in. wide.

Possible applications of this machine in tropical agriculture would be for cleaning the subsidiary drains in the heavy clay soils on which coconuts are grown in Malaya, where the palms are wide planted and set uniformly in regular rows, or for cleaning minor drains and ditches in paddy fields in the dry season before the rains. Obstructed and silted drains are a frequent cause of flooding and crop spoilage.

MACHINERY AND EQUIPMENT

Land clearance and irrigation special edition

'Plastidry' hose requires no drying and rolls up into a flat coil. It is unaffected by contact with acids or alkalis, mineral or vegetable oils, or brine or corrosive gases

Plastic Hose for Irrigation

In irrigation, the need often arises for flexible, easily portable pipelines and hoses which can be quickly and easily laid, are light and manually transportable, and require no maintenance. To meet this need, there has recently been put on to the market a new type of hose having a number of important advantages over the more conventional equipment. The hose is available in $1\frac{3}{4}$ in., 2 in., $2\frac{1}{2}$ in., $2\frac{3}{4}$ in., 4 in. and 6 in. diameters.

'Plastidry' hose, manufactured by British Tyre & Rubber Co. Ltd., consists of a P.V.C. cover and lining fused on to an all-nylon reinforcing fabric to form a plastic mass of great strength and outstanding resistance to wear. It coils quite flat, requires no drying, and may be stored anywhere under any condition without detriment as it is completely rotproof. Thus, it can safely be left lying in the open, across fields and broken terrain, or immersed in water in any climate.

The new hose is equally valuable for use in arctic and tropical climates because it remains flexible and easy to handle at sub zero temperatures, and its maximum operating temperature is 248°F. and even higher if water is passing through the hose. It is unaffected by contact with oils, acids and alkalis and may be exposed for years to sea air, brine, ozone and chemical laden atmospheres without coming to harm. Any kind of water, fresh, salt or polluted, can be carried through the hose, and it may also be used for fertilising and crop-spraying fluids. It is also immune to attacks by rats, insects and fungi.

Tests have shown that, because its P.V.C. cover is specially compounded to protect the reinforcing fabric, it is the only hose of the 'coil flat' type which can be exposed to strong sunlight for prolonged periods without suffering any appreciable deterioration in strength. The tough, hard-wearing P.V.C. cover is also protected by a raised pattern finish which provides a non-slip grip for handling and ensures that the hose can be dragged over the roughest ground normally without damage.

Ease of maintenance is an important feature of Plastidry hose. If, through exceptionally rough treatment, any of the outer P.V.C. cover suffers abrasion, immediate repairs can be carried out, even by unskilled workmen, if a soldering iron is available.

Reader Service

For further information on any item of machinery or equipment reviewed in this section please write to:

Reader Service,
WORLD CROPS,
Stratford House,
Eden Street, London N.W.1,
England

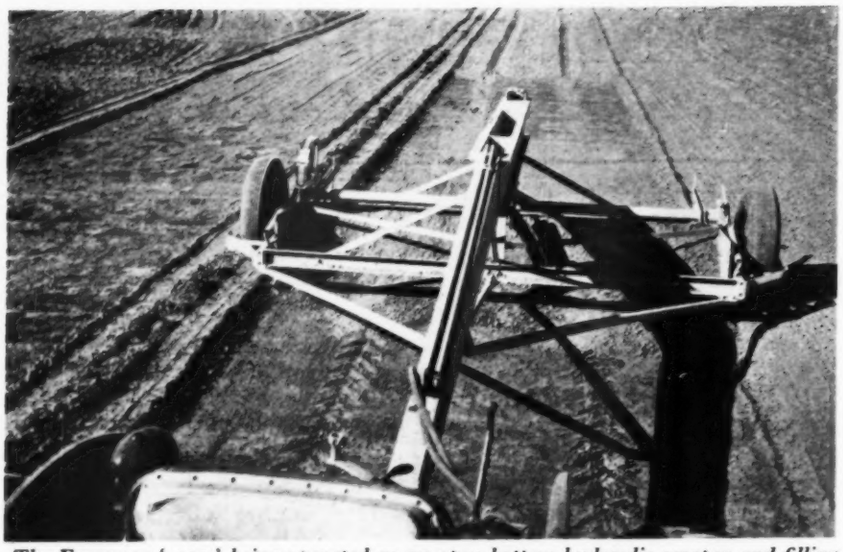
Heavy Duty Earth Scrapers

Two new earth scrapers are now in production by the International Harvester Co. of U.S.A. Payscraper model 75 with 262 h.p. has a capacity of 20 cu. yd., heaped and the model 55 of 172 h.p. can take 14 cu. yd.

New features introduced into the new models are: (1) straight-back bowl, (2) lower draft frame, (3) greater visibility, (4) a new cerametallic clutch, (5) higher apron lift, (6) bigger push block, and (7) improved ejector. These improvements in design are the result of close customer co-operation and engineering experience under field conditions.

The back of the Payscraper bowl is now similar to a dozer blade; the dirt boils back into the bowl from the cutting edge, fills the corners and accumulates a full load in a few seconds. The new cerametallic clutch is a combination of powdered metals and ceramic materials and this provides more positive clutch engagement and reduces slippage. The higher apron lift ensures the speedy ejection of the accumulated dirt and then the apron closes quickly with a guillotine action. The bigger and wider push block enables the operator to direct

A giant at work. The International 'Payscraper', Model 75, of 262 h.p., has a heaped capacity of 20 cu. yds.



The Eversman ' 329 ' being operated as an open-bottom hydraulic scraper and filling up low spots with dirt

the pusher thrust more effectively and it also helps to protect the tyres. The lower draft frame gives the driver improved vision of both the bowl and the push tractor.

He sits on a thick foam-rubber seat with the operating controls within easy reach. Other features are the heavy-duty, two-shoe air brakes, which are synchronised on both tractor and scraper wheels, while an anxiliary hand brake provides individual braking of the drive wheels for use when getting out of rough ground. Multiple-disk cable control assures fast and efficient scraper action.

The steering is effortless due to the International Hydro-Steer, a device operated by hydraulic power. The operator is in complete control of the machine, with the added advantages of safety and comfort.

The new Payscrapers have been thoroughly tested in the field and the makers are confident that they will find ready acceptance.

Improved Land Smoothing and Dirt Moving

The Eversman Manufacturing Co. of U.S.A., makers of land-levellers and dirt-movers since 1928, has just announced its new Land Smoother and Hydraulic Scraper—the Eversman 329, which is also the complete tool for seedbed preparation, because a smooth field provides a superior seedbed and permits more effective utilisation of irrigation water with more uniform surface drainage. They claim that it represents a tremendous advance in the levelling and earth-moving field, as a result of basic changes in the design of the crank axle.

The machine is 32 ft. 6 in. long and 12 ft. wide, weighs a little less than a ton (2,010 lb.), has $1\frac{3}{4}$ cu. yd. dirt capacity, and can be hauled by any 3-plough tractor. It is larger, heavier, and stronger, yet simpler in construction, has fewer moving parts, and actually sells for a lower price than the former Eversman model of the same capacity.

The faster and more accurate levelling action of the Eversman 329 is the result of two basic changes in design :

(1) The main wheels have been moved farther ahead of the blade. As a result the blade lowers at an earlier point on the high spots and starts to cut sooner. The blade likewise raises to dump earlier, resulting in overfilling of the low spots which will allow for the subsequent dirt settlement. Furthermore, in moist, sticky soil conditions, the dirt can be shed from the blade before the low spot is passed.

(2) Another important feature of the new crank axle design is that it alters the relationship between the tension springs and the movement of the main wheels, so that a much greater percentage of the weight of the leveller is transferred to the cutting edge and less weight remains on the main wheels during a cut. This permits the blade to make the maximum cut possible. When the wheels lift the blade to dump dirt in a low spot, the tension springs again accelerate the action to give quicker filling.

Other new features are a screw adjustment on the front clevis, which provides quick and easy control of the amount of dirt, carried in the blade; an automatic cylinder lock valve for the hydraulic system, which keeps the cutting blade in a fixed position, so that it will not drift or lower, due to a faulty hydraulic system on the tractor; the blade vertical travel has been increased to give a 13 in. clearance, making it easier to stockpile or windrow dirt for building levees or dykes for border irrigation or for transporting.

The machine has dolly wheels for use in moist, trashy, loose soil, or a V assembly for dry, cloddy ground. The rear smoother blade is adjustable to all soil conditions and is equipped with a positive locking device, so that it will maintain its position. The machine may be telescoped and moved on its own rubbered tyres from field to field behind a tractor or truck.

The result is a machine which is claimed to be the most efficient and fastest farm tractor-pulled land leveller, dirt mover and tillage tool ever produced, and in spite of all the improvements which have been incorporated, it is simpler in construction and has few parts, so that it is cheaper to produce.

Square Irrigation

It is claimed that irrigation will prove just as important to agriculture in the second half of this century as mineral fertilisers were in the first. The main problem will be to make the best use of the available supply of water.

For many centuries man has tried to overcome deficiencies in rainfall by irrigating the thirsty land. Formerly simple flood irrigation through a system of drains and ditches was followed; the modern method is by overhead spraying—a form of artificial rain.

The conventional overhead irrigating equipment sprays the water in circles. Thus sections of the circles must overlap and some parts of the ground will then receive twice as much water as the rest or; if the circles do not overlap, there will be areas which will receive no water at all.

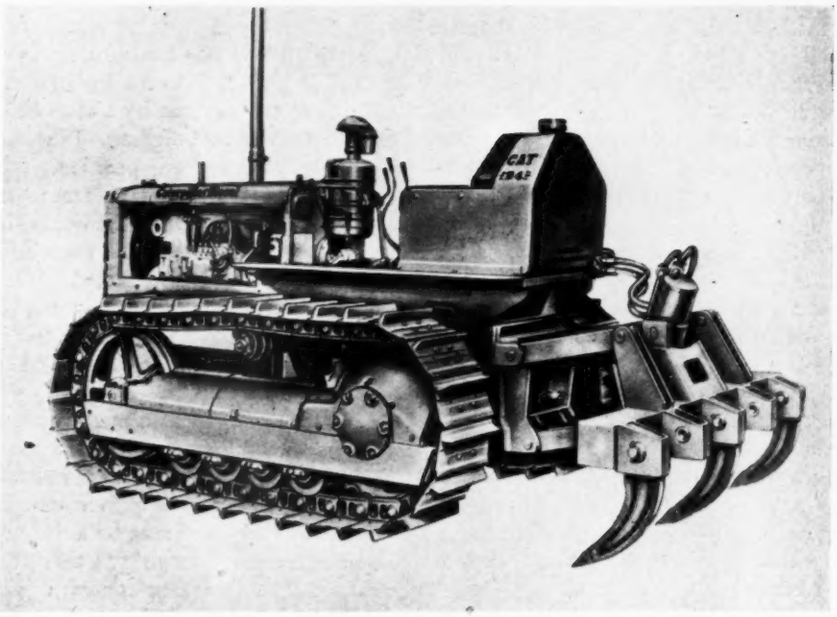
Alternatively there may be some overlap and some ' blind ' spots.

The new overhead irrigation equipment, supplied by Farrows, sprays in squares and provides an even fall of rain over the whole area; there are no dry patches and no water-logged patches. The consequent saving in water is 18% and this is an important factor where the supply is not abundant. There is also a corresponding saving in time and in a given period it is possible to irrigate 20% more land with square-spraying equipment than with circle-spraying equipment.

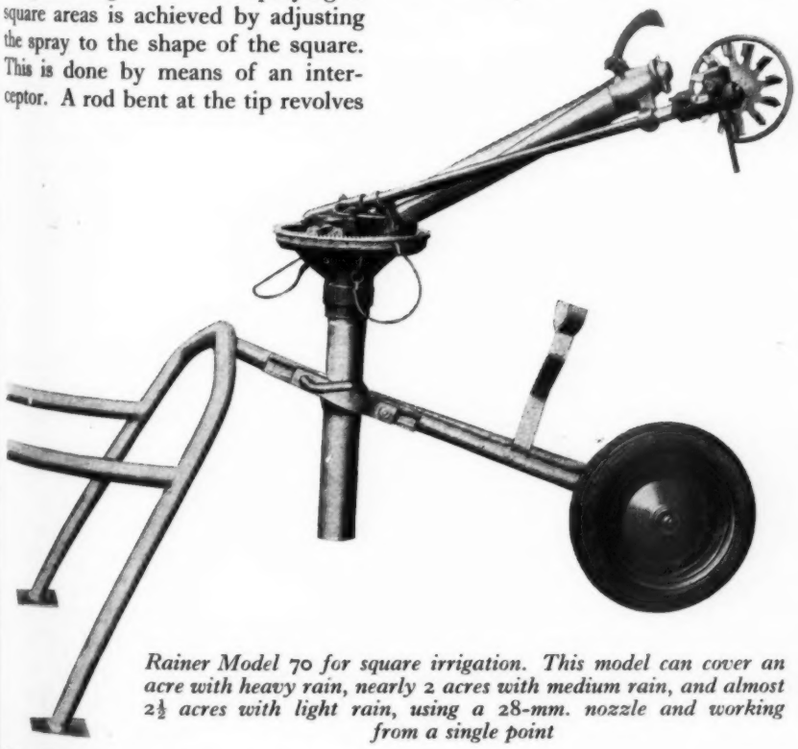
Four sizes of rainer are produced—models 25, 50, 70, and 100. The smallest, for use on small areas, will cover 364 sq. yd. from one position; the largest can cover a square area of 2½ acres, also from a single position. The stream of water leaving the nozzle under pressure strikes a turbine wheel causing it to rotate, either clockwise or anti-clockwise, according to requirements. The length and type of jet depend on the size of nozzle and the setting of the turbine, making it possible to put down three types of rain—heavy, medium, or light. Heavy rain is in visible droplets, while light rain is more like a heavy mist. A screw can be manipulated to control the intensity of the rain, the length of the jet, and the rotation speed of the rainer.

Square irrigation or the spraying of square areas is achieved by adjusting the spray to the shape of the square. This is done by means of an interceptor. A rod bent at the tip revolves on two bearings; it has an arm attached which travels on a circular track through an adjustable screw. This track rises gently as the spray moves round from the longest throw (the diagonal) to the shortest throw (the centre point of the side of the square) and falls again as the spray approaches the next diagonal. As it rises, the tip enters the jet and as it falls the interceptor leaves the jet. In a complete rotation of the rainer, the interceptor enters and leaves the jet four times and so adjusts the spray to the shape of the square.

As the turbine wheel is brought further into the jet of water, it causes the rainer to rotate faster, shortens the jet and breaks the water up into a finer spray. Such shortening of the jet may be necessary if the area to be irrigated is smaller than the maximum capacity of the rainer. This will cause a smaller square to be irrigated and will thus avoid any overlapping of the square-sprayed areas.



The new No. 4 ripper for use with the Caterpillar 60-in. gauge D4 tractor is equipped with a carriage bar which carries from three to five formidable steel claws



Rainer Model 70 for square irrigation. This model can cover an acre with heavy rain, nearly 2 acres with medium rain, and almost 2½ acres with light rain, using a 28-mm. nozzle and working from a single point

New Five Tooth Ripper

A new ripper for use with the Caterpillar 60-in. gauge D4 tractor has been announced by Caterpillar Tractor Co. It is designed for D4 tractors having grouser widths up to 18 in. and the added versatility will result in higher production.

The No. 4 Ripper is constructed to withstand the hard punishment of ripping such materials as shale, hardpan, and rocky or frozen ground.

Since the three alloy-steel ripping teeth are removable, the No. 4 Ripper has three notable features. First, the user has a choice of the number of teeth to be used. Secondly, when ripping to the edge of vertical walls or banks, the teeth may be inserted backwards, and ripping performed while backing up. Further, by inserting the teeth upside down when not in use, additional ground clearance may be obtained. Provision is

made for fitting two additional teeth, all of which have replaceable tips. When working in hard material, the full power of the machine can be absorbed by one tooth at maximum penetration without damage to any part of the ripper. Another feature of the No. 4 Ripper is its parallel linkage, which maintains a uniform ripping angle at all penetration depths. This not only produces maximum ripping action but also protects the hydraulic system by reducing cylinder pressures.

With the ripper mechanism fully retracted, the length of the D4 tractor is extended only 28½ in., providing easy maneouvrability in confined areas. Enough ground clearance is provided to allow the D4 to climb a 30° incline without striking the ground with the teeth.

Maximum ground penetration of the No. 4 ripper is 12 in., ripping width up to 71 in., and ground clearance (fully raised) 15¼ in.

For Clearing Land

The Brayloader 25 is a fully-tracked shovel bulldozer, which is operated by a Ford diesel engine, developing 42 b.h.p. at 1,750 r.p.m., which appears to be very suitable for clearing bushy scrubland, secondary jungle or blukar. The control of the operator over the bucket is such that the roots and undergrowth are claimed with only a minimum of the valuable top soil. The scrub is then lifted and transported to a pile for burning.

Larger trees, up to 10 in. in diameter, can be removed by a combination of pushing and digging. With its bucket in the raised position, the machine loosens the tree from its socket by pushing. Then the bucket is dug down into the loosened roots and the tree is painlessly extracted. This is very similar to the way in which elephants are used to push over trees, except that the roots of the tree have to be cut with an axe.

The Brayloader has a massive sub-frame directly associated with the track and providing the mounting points for the loader unit. The power unit is carried by this sub-frame on a flexible cradle, thereby ensuring that all loading and steering stresses are absorbed by the sub-frame and not by the power unit itself. The main frame of the shovel is box-sectioned to give it adequate reserve of strength. Similarly half-shaft and axle bearings have been designed to accept the stresses and strains of a heavy demand of power.

Winches at Work

A winch is like the arm of the law—long, strong and inexorable. A good winch can effectively apply all the power that is available, so say T. T. Boughton and Sons.

This company has received official approval of their winches from Bristol, David Brown, Ford, International, Rotary Hoes and Massey-Harris of the U.K., and St. Chamond of France. Today they have over 90 versions of their winch to suit different makes and sizes of tractor.

A caterpillar tractor fitted with a Boughton winch hauling a tremendous load

The winches are mostly sold for forest, jungle and scrub clearing, but in the agricultural field they are being increasingly used for mole draining and for hauling bogged vehicles out of sand or heavy mud. They will have an obvious application in the clearing of old plantation crops, such as coconut or rubber, prior to replanting, which has now become a major problem in the tropics.

A Monkey Winch

The ' Trewhella ' monkey winch is a labour-saving appliance for dealing with standing timber and stumps. It is a sturdy, compact and handy device, which makes it possible for two men to do the work of many, and in far less time than by ordinary methods.

The enormous pull it can exert is obtained simply by hand power scientifically applied. There is no horse to feed and no fuel to be provided, and the winch costs practically nothing to maintain. A few drops of oil daily is all the attention it requires.

Its operation is quite simple. One end of a steel rope is fastened well up the trunk of the doomed tree; the monkey winch is secured by another wire rope fastened low down on an adjoining tree. The wires are connected and are drawn up tight by a to-and-fro movement of a 5-ft. lever arm. This revolves the drum of the winch and gradually a pull is exerted on the tree, which is ultimately torn

The ' Brayloader ' 25 clearing scrubland. The bucket can be seen dozing the scrub, which it will then scoop up from the earth

from its seat, bringing all the roots with it. No digging or cutting is necessary.

The ropes supplied with the implement will enable trees to be pulled up which are as far as 150 ft. from the anchor tree and thus from one anchorage it is possible to reach all the trees on over 2 acres of land. As a result it is possible to extract as many as 27 medium-sized shallow-rooted trees in 2½ hours, according to an actual trial by the Ministry of Agriculture. Larger trees will, of course, take longer. Thus, for instance, 88 good-sized trees were extracted by two men and a supervisor in five days.

For dealing with ground - level stumps a stumping trestle is used to obtain an upward pull and so obtain a lifting action. There is also a hook which can be attached to the winch for hauling stumps, gripping awkward objects and rolling logs. The monkey winch can be used for pulling timber out of rivers and lakes, for demolition work and for moving bogged lorries and tractors.

It can be taken almost anywhere—up steep hillsides or among heavy undergrowth—without any necessity for clearing a working space.

The Australian monkey winch tearing a tree bodily out of the ground without any cutting round or other preparation

On any estate, the 'Trewhella' monkey winch should soon pay for itself many times over; to the horticultural contractor or jobbing gardener it is an indispensable implement for removing dead trees and for clearing wooded land.

Versatility

World agriculture provides an infinite variety of conditions to test the versatility of equipment. One of the special advantages of the International Harvester B-250 tractor is its ability to transfer implement weight and work forces through the linkage to the rear wheels, thus increasing traction; but under the loose powdery conditions of the silt at the Perkerra Irrigation Scheme, near Lake Baringo, East Africa, which provided little flotation for any tractor, this added weight was no advantage, as the implement kept pulling the tractor deeper and deeper into the dust. The B-250, however, can be used without this weight transfer, by using special toolbar depth wheels. This makes it possible to pull four middlebusters or ridgers without the 12-ft. outfit sinking further into the silt.

The International Harvester B-250 tractor can be used with or without weight transfer, according to conditions

On the adjacent hard ground, weight transfer could be reintroduced, with a marked increase in working speed.

International Harvester of East Africa believe this versatility is exactly what is needed for their highly diversified conditions.

Artificial Rain

Wright Rain Ltd. have produced a comprehensive folder, giving an account of the sprinkler system of irrigation, which has the merit of making a little water go a long way—a very important point where there is only a limited supply in certain seasons.

Ordinary methods of irrigation gives water in excess of the soil capacity which is not only bad for the crop but when the land is saturated, the excess runs off and is wasted. Wright Rain moistens the soil, the pasture or the crop just like natural rainfall. It is easily controlled and it is possible to apply just as much or as little as is required according to the limitations of the water supply or the exact needs of the plants for efficient production. It is claimed that considerable increases in yields of pasture have been obtained by sprinkler irrigation. Other crops which are specially benefited by this system are tobacco, cotton, sugar-beet, fruits and vegetables, and there would appear to be a special application for forestry, tea, rubber and coconut nurseries.

The sprinklers are of the slow-rotating type. The pipes and fittings are of aluminium alloy and so light that one man can move 660 ft. of line to its next position, 60 ft. away in 51 minutes.

A typical layout for a 40-acre field is described. Operating a 10-hour day, each lateral line will cover approximately 2.7 acres, the whole 40 acres receiving an application of 1 in. of water in 7½ days with 22 moves of each lateral line. The basis is an application rate of 1 in. in 3 hours for a medium soil.

An account is also given of the Wright Rain fertiliser applicator through which soluble fertilisers in

A small Wright rain unit, consisting of a tractor-driven pump, a manifold pipeline and rotating sprinklers

weak solution may be applied to the crop through the sprinkler system.

There are various sizes of diesel-driven pumps for operation with the Wright Rain system and a tractor pump which can be operated by any tractor having a clockwise rotation of the p.t.-o., when viewed from the rear. The T3 tractor pump is mounted on a two-wheel trolley, is completely mobile, and can be attached to the tractor in a matter of seconds. It can be left unattended for hours in the sure knowledge that it will continue to operate efficiently.

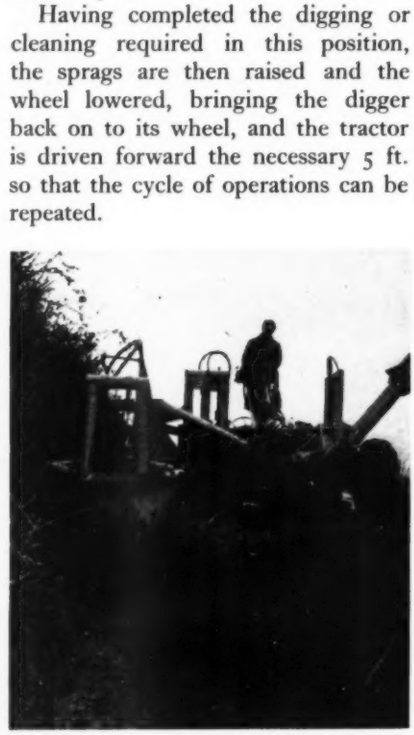
The Landrainer

The modern application of hydraulic power has made possible the development of a machine based on a drag-line system devoid of winches and pulleys and the consequent high cost of loading and transporting. The new W. & G. ' Landrainer ' is the result of several years of design and development under actual working conditions. It is designed to work in conjunction with the Fordson diesel tractor or similarly powered tractors. The complete ditching machine is attached to the tractor drawbar by a drawbar pin in exactly the same manner as a trailer and therefore can be removed from the tractor in a matter of seconds.

This machine can carry out digging, trenching and trench dredging operations at considerable speed and with the utmost simplicity of control. It can cut most types of ditches to a depth of 8 ft. and width of 6 ft. No hand finishing is necessary. Various types of buckets are available to suit different local conditions and special buckets are available for such operations as pipe laying etc. Spoil from the ditch can either be deposited behind the machine, well clear of the ditch, or can, if necessary, be loaded straight into a trailer or tipping lorry. Work has been carried out under really bad conditions, such as waterlogged ground, sandstone shale and large roots.

The ' Landrainer ' is towed behind the tractor in the form of a trailer and is driven alongside the work to be carried out. All operations are then conducted by means of the bank of levers mounted on the machine within easy reach of the tractor seat with press-button simplicity. First, two large powerful sprags are lowered to the ground and the offside pneumatic wheel raised to hold the machine to its work. By varying the height of either of the two sprags or the position of the retracting wheel, the machine can be set either towards the ditch or away from it, ensuring that the bucket, when cutting, is always vertical. A telescopic boom working on the drag-line system and controlled by a push–pull hydraulic ram is extended to its full length (about 5 ft. extension is provided) and the bucket is then tilted and dropped on to the face of the job. To dig a ditch approximately 3 ft. or 4 ft. deep an average of three cuts is usually necessary.

Having completed the digging or cleaning required in this position, the sprags are then raised and the wheel lowered, bringing the digger back on to its wheel, and the tractor is driven forward the necessary 5 ft. so that the cycle of operations can be repeated.

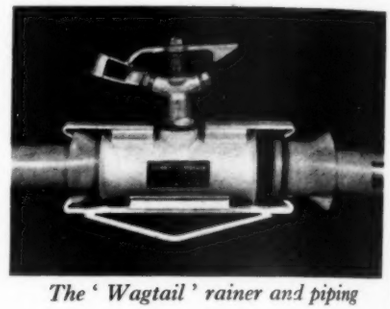


Rear view of ' Landrainer '. This machine can cut a standard agricultural ditch at a rate of about three chains per hour. The bucket can be elevated to a height of 10 ft. to enable easy loading of the spoil into lorries

Irrigation Piping and Rainers

'Wagtail' piping and rainers, manufactured by Guthrie Allsebrook, are suitable for market gardens, grasslands and pastures, orchards and nurseries.

The piping, which is made of red ' rigid U.P.V.C.' plastic, is light and strong and is supplied in convenient 20-ft. lengths and in three sizes—1½ in., 2 in. and 3 in. The lengths are joined by metal couplings simply by a push and a twist.



The ' Wagtail ' rainer and piping

The rainers take between half and one minute to rotate and each covers a circle from 50–75 ft. in diameter, depending on the nozzle size and water pressure. They are usually spaced at 40-ft. intervals to ensure thorough coverage.

Interchangeable nozzles will give from 1–15 gal./min. consumption by each rainer, and high, medium or low trajectories, according to requirement. Low trajectory is preferred for orchards, and medium suffers less from wind-drift than does the high trajectory. A pressure of 25 lb./sq. in. will give a fine rain, while at 10 lb./sq. in. the rain will be heavier and the rainer will rotate more slowly.

What Irrigation is Doing

Crops valued at £A16,300,000 were produced last year on Queensland's irrigated farms, which now cover 121,414,000 acres.

Of the irrigated area, 63,323 acres were under sugar-cane, 23,285 acres under fodder, 18,835 acres under vegetables, 4,533 under tobacco and 3,001 under fruit.

In spite of the abnormal rainfall this season, a growing interest in irrigation is reported. This was indicated by an increase in the number of licences issued to divert water from streams for irrigation, the number of bores drilled by the Commission, and provision of water supply and irrigation advisory services to some 650 landholders.

Agricultural Chemicals

Herbicides: food preservative and additive: a new wetting agent for plant-protecting chemicals

General Purpose Herbicide

Chemical control of weeds is now established as quicker, cheaper and more efficient than hand or mechanical weeding, but it still has limitations. There are sometimes personal hazards of fire or toxicity. With water-soluble products there is the risk of migration to adjoining cultivated ground. Treatment usually needs to be repeated during the season, and this can involve the transport and storage of chemicals in large quantities, as well as heavy labour costs.

Geigy weedkiller, the new general-purpose weedkiller, is free from many of these drawbacks and has certain advantages. It is used in small quantities and one application is enough for a year, so that in cost per unit area and ease of application it compares more than favourably with other weedkillers in common use.

The active ingredient of this new weedkiller is simazin—a chloroamino-triazine which is virtually insoluble in water. This means that the weedkiller does not leach out and is not carried down by rain, unless the ground is exceptionally porous. On ordinary horticultural soil it stays where it is wanted—in the top few inches of soil. It can safely be used round trees and deep-rooted shrubs, and is particularly useful on paths, such as those between beds or frames.

Geigy weedkiller is not a hormone weedkiller and has very little direct action on or through the foliage. It acts on the growing plant through the root system and the effects are not normally visible for three to four weeks. Within a month, however, most of the shallower - rooted weeds, including annual grasses, wither and die; deeper-rooted perennials take longer, especially if they are well established and already making strong growth. For these reasons, although Geigy weedkiller can be used at any time, it is best applied in early spring, when growth is just beginning. Very good results are obtained by preventive treatment of ground which is still clear but on which weeds are expected to grow later. One application in spring is enough to keep the ground clear of weeds throughout the growing season. Geigy weedkiller does not stop germination, but any plants that do come up will not survive the seedling stage.

*

Vegetable Preservative

Dr. R. S. Cox, of the University of Florida, Everglades Experiment Station, has reported that radishes subject to a storage and transit disease known as ' radish pit ' were 50% less susceptible when dipped in ' Biostat ' solution. 'Biostat' is a food-preserving formulation containing the broad-range antibiotic oxytetracycline.

Symptoms of this disease, a serious threat to the American radish industry, appears initially as water-soaked areas within 48 hours after harvest. These areas develop into pitted lesions within three to five days. ' Biostat ', however, gave striking control over this disease. It was found to be much more effective than streptomycin, which was also tested.

*

Nitrogen for Cereals

The two most important considerations in growing a profitable crop of cereals are: (1) choice of variety and (2) use of nitrogen fertiliser. There are, of course, many other factors involved, but the application of nitrogen fertiliser at the right time to a suitable variety is the certain way of obtaining higher yields of grain per acre at less cost per ton.

Winter wheat.—Amongst the new stiff-strawed varieties, Cappelle Desprez, Hybrid 46 and Ministre are outstanding for their yield capacity and resistance to lodging. They should be top-dressed with up to 4 cwt. sulphate of ammonia or 5 cwt. ' Nitro-Chalk ' per acre, depending on local conditions. Time of application should be decided for each field, according to the following principles:

(*a*) February/March application increases tillering and growth of flag and in most seasons has a decisive effect on grain yield. Early application is usually most satisfactory on a well-spaced plant and is essential on a plant thinned during the winter.

(*b*) April/early May application after tillering has ceased increases grain yield without having much effect on straw height.

(*c*) Very late application, *e.g.* mid-June, results in higher protein content of the grain rather than in increased yields.

It often pays to divide the dressing, giving half in February/March and the remainder in April/early May.

Winter oats.—S.172 suits conditions of high fertility better than S.147. Top-dress with up to 3 cwt. sulphate of ammonia or 4 cwt. ' Nitro-Chalk ' per acre in April or early May. For other varieties, including S.147, top-dress at the same time with only half this amount.

Spring wheat.—Atle, Atson and Koga 2 are all inherently strong standing and high yielding, but need plenty of nitrogen. They should be combine-drilled with compound fertiliser containing the equivalent of 1 cwt. sulphate of ammonia, followed by a top-dressing of 2 cwt. sulphate of ammonia or 3 cwt. ' Nitro-Chalk ' per acre during April or early May. Late-sown crops, and those in the drier areas, may be given all their nitrogen requirements in the seed bed, *e.g.* 3 cwt. sulphate of ammonia or 4 cwt. ' Nitro-Chalk ' per acre, part combine-drilled and part broadcast.

Spring barley.—The varieties Proctor, Herta and Rika are the highest yielders amongst the feeding barleys. They should receive the same treatment as the spring wheat varieties mentioned above.

If grown for malting, the dual-purpose variety Proctor requires a seed bed application of 1 cwt. sulphate of ammonia, followed by a top-dressing not later than mid-April of 1½ cwt. sulphate of ammonia or 2 cwt. ' Nitro-Chalk ' per acre (or the whole amount in the seed bed).

Spring oats.—Milford has a high resistance to lodging and will give very high yields when generously fertilised with nitrogen. It should be combine-

drilled as for spring wheat above, followed by a top-dressing of 1½ cwt. sulphate of ammonia or 2 cwt. ' Nitro-Chalk ' per acre during April or early May. Alternatively, all the nitrogen may be given in the seed bed.

Sun II, Blenda and Forward should be given a total of 2 cwt. sulphate of ammonia or 3 cwt. ' Nitro-Chalk ' per acre, applied in two dressings, *i.e.* half in the seed bed and half as an April/May top-dressing.

*

A New Wetting Agent

The addition of a wetting agent has been shown to increase substantially the biological efficiency of plant protection chemicals, particularly on crops with waxy leaves, such as cabbage, onion, citrus and banana. Trials conducted by Plant Protection Ltd. all over the world have shown that 'Agral' 90—a new synthetic wetting and spreading agent—greatly increases the efficiency of copper sprays for protection against potato blight and banana leaf spot. It is also particularly effective with dispersible sulphur against apple mildew, since this fungus is water repellent, and for obtaining maximum weed control with sodium nitrate when this chemical is used as a weedkiller on sugar-beet and mangolds.

Recent experiments with 'Agral' 90 have also shown that, if incorporated in a sodium arsenite spray for lalang and other weeds in rubber plantations, the rate of sodium arsenite can be reduced from 2½% to 1%.

It is compatible with most sprays used in crop protection and is readily miscible with both hard and soft water in all proportions and at all temperatures.

*

Feed Additive

Roche Products Limited announce that their new plant for the large scale synthesis of vitamin A is now coming into production. Manufacture of the first batches of synthetic vitamin A acetate has already started and production will be gradually stepped up so that by the middle of the year the plant will be working to full capacity producing high potency acetate and palmitate concentrates.

Although it was as long ago as 1931 that the structure of vitamin A was announced by Karrer *et al.*, it was not until 1947 that a practical synthesis of this delicate and complicated molecule was achieved by Isler and his research team in the Roche laboratories in Basle.

The large scale synthesis of vitamin A is one of exceptional complexity involving 14 distinct stages in the process of building up the final compound. There followed the difficult task of transforming the laboratory synthesis into a plant scale process. Early in 1950 the major development problems had been overcome and the first large-scale plant was producing to full capacity. Since then two manufacturing units within the Roche organisation—one in Switzerland and the other in America—have had to meet the growing world demand for synthetic vitamin A concentrates. The new British plant will now provide a welcome addition to the world output of this important nutrient.

With the introduction of high-potency synthetic vitamin A concentrates, the problem of producing preparations to facilitate the vitamin A standardisation of animal feeds has stimulated the development of free-flowing powders. In this field Roche Products Limited were among the first to introduce powders in which the vitamin A is protected from oxidation and the adverse effect of moisture and minerals, whilst at the same time maintaining full biological activity and availability to the animal. These mineral-stable premix powders, made from their vitamin A concentrates, are marketed as a livestock feed under the trade name of ' Rovimix '.

*

Selective Weedkiller

' Agritox ' brand selective weedkiller contains 25% MCPA in the form of its potassium salt. It is recommended for use in autumn- and spring-sown wheat, barley and oats, in linseed, grass for seed, and grassland. Any efficient high- or low-volume sprayer may be used, as ' Agritox ' does not clog or corrode machinery.

Weeds Affected by 'Agritox'

Weeds in cereals and linseed	*Growth stage of weed*	*Rate per acre, pints*
Black Bindweed (*Polygonum convolvulus*)	Seedling	5
Charlock (yellow) (*Sinapsis arvenis*)	4–6 rough leaves	2½
Chickweed (*Stellaria media*)	Young seedling	5
Corn buttercup (*Ranunculus arvensis*)	Seedling	4½–5
Cornflower (*Centaurea cyanus*)	Seedling	5
Corn gromwell (*Lithospermum arvense*)	Seedling only	5
Day nettle (hemp nettle) (*Galeopsis tetrahit*)	Seedling	5
Fat hen (*Chenopodium album*)	Seedling	4½–5
Field bindweed (*Convolvulus arvensis*)	Before flowering	5
Field cabbage (*Brassica rapa*)	Seedling	4½–5
Fumitory (*Fumaria officinalis*)	Seedling	5
Groundsel (*Senecio vulgaris*)	Seedling	5
Knotgrass (*Polygonum aviculare*)	Seedling	5
Orache (*Atriplex patula*)	Seedling	4½–5
Pennycress (*Thlaspi arvense*)	Seedling	2½
Poppy (*Papaver rhoeas*)	Young seedling	5
Redshank (Willow-weed) (*Polygonum persicaria*)	Seedling	5
Runch (white charlock, wild radish) (*Raphanus raphanistrum*)	4–6 rough leaves At later stages	4–4½ 5
Scentless mayweed (*Matricaria maritima*)	Young seedling	5
Shepherd's needle (*Scandix pecten-veneris*)	Seedling	5
Shepherd's purse (*Capsella bursa-pastoris*)	Seedling	4½
Small nettle (*Urtica urens*)	Seedling	5
Sowthistle (annual) (*Sonchus oleraceus*)	Seedling	5
Speedwells (*Veronica spp.*)	Seedling	5
Tares (vetches) (*Vicia spp.*)	Start of climbing	5
Treacle mustard (*Erysimum cheiranthoides*)	Seedling	4½

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WORLD CROP REPORTS

World Record Maize Crop

INTERNATIONAL

Maize

World maize production for 1956–57 is estimated by the U.S. Department of Agriculture at 6,585 million bushels, a new record. This is 45 million bushels higher than the 6,540 million crop forecast by the Department last October and compares with production in the 1955–56 year of 6,275 million bushels. The report said that the bulk of the increase took place in the U.S.A. and the Soviet Union. European output was smaller than last year. Asian production would probably be above 1955, while African output would be about the same. The Argentine crop is forecast as 115 million bushels, compared with the 1955 output of 152,350,000 bushels.

Detailed reports received on the maize crop in Africa say that a record approaching 3,900,000 bags is expected to be produced by European farmers in Southern Rhodesia during the 1956–57 season, which is about 400,000 bags more than the previous season's crop. This will mean a further considerable addition to Rhodesia's already substantial maize surplus, as the country's maize requirements are about 3 million bags a year. It is estimated that this year's crop, about 10.2 bags per acre, is about the same as last year, but much higher than in previous years.

Kenya's maize crop is said to be 'quite satisfactory' and 20,000 to 30,000 tons will be exported. The crop from the European producing area is likely to be 950,000 bags, but the crop of about 475,000 bags from the Nyanza area is disappointing, because the excessive rains have rotted seedlings.

In the Union of South Africa good early rains in the Free State and the Transvaal have laid the foundation for a good crop this season. Provided normal rains fall between now and the harvest, the record of 39,010,000 200-lb. bags set up in the 1944–45 marketing season seem likely to be broken.

The Division of Economics and Markets estimates this season's South African maize acreage to total 3,926,000 morgen (one morgen equals 2.116 acres). The previous season's acreage was 4,071,000 morgen.

Wheat

World wheat production for 1956–57, the current crop year,* is likely to be about 121 million metric tons, some 2 million tons below production for 1955–56, according to an FAO report. The figures do not include production in Eastern Europe, the Soviet Union and China.

Efforts to cut production in the U.S.A. and Canada, the two major producers, have been defeated by high yields. It is estimated that the U.S. crop yielded 27.1 million tons, 7% above the previous year's output. With present stocks of 28 million tons supplies for 1956–57 may reach the all-time record of 55.1 million tons. In Canada high yields more than compensated for acreage reductions and it is estimated that production for 1956 rose 1.2 million tons over the previous year's production of 13.4 million tons. The total wheat supply for 1956–57 is 29.2 million tons, the largest in Canadian history.

On the other hand, production in Western Europe dropped from 37.8 million tons in 1955 to 31.9 million in 1956, despite increased harvests in Scandinavia, Spain, Portugal, Western Germany and Britain. Late frosts in France reduced production to 5.7 million tons, compared with 10.4 million in 1955. Belgian and Italian production was also down.

South Africa has prospects of a record high crop of new wheat, as well as a heavy carry-over, and it is thought that she may soon begin exporting wheat.

The wheat crop in Brazil for 1956 was expected to reach 1,200,000 tons, the largest crop that has ever been recorded and amounting to no less than three times the 1951 crop.

Wood

The world's forests yielded 3% more wood in 1955 than in the previous year, it has now been reported by FAO. Slightly higher prices and an increased output of processed commodities at the same time increased the estimated market value of the yield by more than 7% over that of the 1954 output.

The total fellings were 1,465 million cu. m., against 1,424 million cu. m. in 1954. The growth of output was greatest in the North American region, where production rose by more than 5%, with a rising trend also evident in Europe, the U.S.S.R. and Asia. Estimated value of all forest products was $29,800 million, against $27,800 million in 1954.

A continuing trend to more rational use of forest resources was noted. Although production of fuelwood has remained fairly stable for several years, this is said to represent a steadily declining proportion of the volume of fellings. But uncontrolled and unreported fellings for fuelwood, on which little data are available, were estimated to comprise as much as 20 times those reported in some Far Eastern and Latin American countries.

U.S.A.

Farm incomes showed an increase during the latter part of 1956 for the first time since 1951 and this upward trend is expected to continue. This is the result of strong demands from consumers, increasing exports of farm products and the existence of the Soil Bank, designed to reduce surplus crop production.

The growing demand for U.S. farm products is expected to continue through the year. The nation's population is continuing to grow and economic activity shows all indications of remaining high. Consumer incomes and expenditures on food are expected to continue the rising trend that showed strongly during 1956. Costs of marketing food may continue to increase in 1957, experts of the Department of Agriculture believe.

The prospects for overseas markets, too, appear to be good.

Supplies of farm products are still in abundance. There were large stocks, particularly of cotton, wheat, maize, feed grains and rice, carried from the 1955–56 crop year into 1956–57. The 1956 total farm production set a new

* The wheat production year used by FAO runs from 1 July to 30 June. Any northern hemisphere harvestings made during May or June are included in the following period. That is, any northern hemisphere harvestings in May 1955 would be included in the 1 July, 1955–30 June, 1956, statistics.

record, despite curtailment in acreage for several major crops, largely as the result of improved crop varieties, increased application of fertilisers and wider use of irrigation.

Despite this heavy production, large exports are expected to reduce the stocks of cotton, wheat and rice. The stocks of maize, however, are expected to increase.

EIRE

Because of the unfavourable soil conditions very few sowings of winter wheat were made in December and the total acreage by the end of the month appeared to be somewhat less than in the same period last year, according to a report issued by the Department of Agriculture in the Republic of Ireland.

Grain quality, except in the later districts, was below average. Flax scutching went on in some mills. Yields generally were lower than in 1955 and fibre quality below average.

Progress with the harvesting of sugar-beet was difficult due to the unfavourable soil conditions, but in most areas it was completed by the end of the month. Yields and sugar content compared favourably with the returns of last year.

Acreage.—The final figures for the area under crops and pasture on 1 June, 1956, issued by the Department of Agriculture, show that there was a decrease of 15,400 acres under corn crops last year.

The actual wheat acreage was 339,600, a decrease of 18,400 acres, compared with the previous year, and the acreage of oats was also down by 20,100, the total figure being 525,100.

Against that there was an increase of 23,000 acres in the barley acreage—from 213,200 acres in 1955 to 236,200 acres. Rye was down from 3,100 to 2,800 acres, but beans and peas increased from 1,700 to 2,100 acres.

Root and green crops also fell by 5,200 acres. The potato crop, at 283,400 acres, showed a drop of 2,200 acres; mangolds were reduced by 1,000 acres, from 63,300 acres to 62,300 acres; and turnips dropped to 118,700 acres, a reduction of 10,400 from the previous year.

The acreage under sugar-beet went up by 3,700 to 58,900, and fodder-beet also increased by 1,600 acres to 12,600. Increased acreages were also recorded in cabbages and other green crops.

The acreage under flax dropped by 200 acres to 1,700. The area under fruit increased by 500 acres to 11,900, and an increase of 7,400 acres was also recorded in the area under hay, which is given as 1,896,600 acres. The total crops amounted to 3,603,900 acres, a decrease of 13,000. The pasture acreage was 8,076,400, an increase of 68 100 acres.

URUGUAY

Excessively dry weather with abnormally high temperatures has given rise to drought conditions throughout the country. Pastures have, however, stood up well to the dry weather, due to abundant rainfall in the early spring.

The harvesting of wheat is well advanced. Low yields are being reported from most areas and a large acreage has been burned by farmers rather than incur the expense of threshing. This year's harvest will, in consequence, fall far short of the 800,000 tons harvested in the previous season. The linseed harvest is also expected to be inferior to that of last year and early maize is considered a total loss. The dry weather has also affected the sunflower-seed harvest and in the case of sugar-beet production is estimated at some 15,000 tons, as compared with 35,000 tons for the 1955–56 crop.

NORWAY

Norwegian farmers have just experienced the best production year on record. The production of grain, potatoes, vegetables and milk was the biggest in history. The potato yield is estimated at 1,400,000 tons, almost 50% more than the previous year.

CANADA

Production of many forage crop seeds in 1956 was the smallest in years. Winter killing in Western Canada seriously affected seed production of most legume crops. In Eastern Canada a late spring, followed by an unusually cool growing season with frequent rain, was not conducive to high forage seed yields. On the other hand, production of pedigreed cereals, flax and other large-seeded field seeds was nearly as large as in 1955, although frost in parts of Western Canada and poor harvesting weather in Eastern Canada affected germination and quality of some of these crops.

ENGLAND AND WALES

Agricultural conditions in England and Wales on 1 March, 1957, have been summarised by the Ministry of Agriculture, Fisheries and Food.

Weather conditions during February were unfavourable for cultivations and sowing except on some light soils. Autumn-sown crops are generally satisfactory. Stocks of winter keep were not unduly drawn on during the month and the supplies remaining should be sufficient.

Weather conditions

The first half of February was generally mild. During this period rain fell in most places nearly every day and there was flooding in many southern districts. A week of colder weather followed, with snow in some midland areas, but milder conditions with heavy rain returned and lasted for a few days. The last two or three days of the month were mostly fine apart from some fog patches. There were slight night frosts, but over most of England and Wales both day and night temperatures were above normal. Rainfall was above average in all areas.

Spring cultivations

In most parts of the country land was too wet to work and, except on some lighter soils, little field work was possible.

Some spring sowing was carried out on small areas of lighter, drier land, but generally, owing to the unsuitable state of the ground, very little drilling was done during February.

Autumn-sown crops

Wheat is strong and healthy; some damage and loss of colour due to waterlogging are reported from several districts. The small areas of *barley*, *oats* and *rye* are forward and look well.

Beans made good progress and are a satisfactory plant.

Pastures

Leys made growth during the month and are healthy and generally forward. Wet conditions have limited grazing.

Permanent pastures have shown some growth during the month in many areas and those free from stock are well forward and in good condition, but where cattle have been outwintered many fields are badly poached.

Potato stocks

Potatoes in stores and clamps are keeping well, but rather more sprouting than normal is reported.